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IN ALL THEIR DEPARTMENTS.

ON THE DRAINAGE AND PROTECTION OF THE SLOPES OF CUTTINGS AND EMBANKMENTS.

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SIR,

In the 25th number of your interesting Journal, there is a general article on the slips or falls of earth from the slopes in excavations through clay, sand, gravel, and chalk, in most of which observations I fully concur, yet the advantages resulting from the application of drainage are not carried to the extent I should have anticipated from the able manner in which the writer has handled the subject generally, showing the effects produced by long continued rains, succeeded by frost; also that of dry weather followed by high winds on the face of the cuttings, which ought particularly to claim the engineer's attention; but there is yet another cause of injury to slopes of a more serious description than any hitherto described. I allude to the heavy falls of snow which commonly occur through every winter, and which, continuing for a length of time hanging on the slopes, will drain itself into their sides. This effect will be produced even in a slope of clay, as this material will absorb moisture under these circumstances to the depth of two, three, or more feet. When the slopes have become thus saturated with moisture, the succession of thaws and frost alternately are almost sure to be attended by heavy slips on the sides of the cuts where no previous drainage has been applied, to the full depth that the water has penetrated the same, and slip after slip will succeed each other, until the whole slides out to at least as far back as the moisture has penetrated. To this I have been an eye-witness in many instances, and have always found it attended with the same disastrous results to the face of the excavation, and not unfrequently the injury has even extended beyond the boundaries of the line of railway. In order to guard against, and more effectually prevent such occurrences, I send you with this communication some drawings of cuts and embankments, showing the manner of draining I would propose, and which I may state has been applied in several instances with great success, both in sand and gravel, and also in clay cuttings and embankments; which latter, in the formation of railways, are decidedly more difficult to contend with than the cuttings. I shall briefly describe the sections in their order as figured on the drawing, and will endeavour to explain as clearly as possible the advantages resulting from the propositions I am about to make.

Fig. 1 shows the cross section of an excavation through alternate beds of sand or gravel, and clay. The porous strata of sand or gravel marked *a* and *b* cropping out on the lands beyond the extent of the railway fence, and also being cut through, as shown in the excavation, receive all the water which may fall in heavy rains or snow, or which may drain into it from the adjoining lands. This water passing along the strata on the surface of the impenetrable body of clay that is underneath, and discharging itself into the excavation, washing along with it parts of the sand, and also small particles of clay, gradually but slowly increases the aperture between those beds, and eventually undermines the mass of clay and soil above it, until at last the whole is precipitated into the excavation, causing what is called a slip of very great extent, covering the rails, and completely blocking up the line of railway to some distance.

To prevent effectually such slips of earth, recourse must be had to drainage, according to one or other of the following plans: first, to trace the outcrop of the porous strata to the fields adjoining, as shown at *c*, which may be done by observing the rise of it across the excavation from the lower side of the stratum to the upper, and taking the difference of height with the level, insert a puddle-dam to cut off the water, as shown at *c e*. By this means, the distance may be calculated with tolerable accuracy, providing no sudden alteration takes place in the rise of the strata, and it will be necessary always to adopt such means, as no indication of the outcrop will show itself on the surface of the land, except in some few cases, where the land is under particular kinds of tillage. The surface being covered with soil to the depth of perhaps nine inches, some difficulty will occasionally be experienced in ascertaining the most proper place to make the drain, but this must be left to the judgment of the engineer. Secondly, to insert a drain along the face of the slope, as shown at *d*, cutting through the tail of the sand, or gravel, and into the bed of clay one foot below the sand before it reaches the face of the excavation; which cut must be puddled with clay on the lower side one foot thick at least, and the whole filled with large rubble stones, so that the water may have free access through them, and that the pressure of water may be considerably removed from the clay puddle dam at *e*.

To the first of these plans there are several objections: as no indication of wet will be shown on the surface of the fields at the outcrop, there will be considerable difficulty in placing the drains in so effectual a manner as they ought to be to insure a proper check to the water; and in addition, damages will be claimed from the Railway Company for trespassing by the occupier of the lands, even when leave is granted, as the land-owners and occupiers are in most instances very difficult to satisfy, when they get the chance of making a claim for compensation. These objections must in a great measure prevent the drainage of water from the railway by this mode; consequently the safest and most prudent, as well as the most effectual plan of cutting off the water, and preventing slips in the sides of the cutting, is by the second method, as before described, and by rubble drains laid from the longitudinal drains, at about every 60 feet, to carry the side drainage down to the railway gutter, as shown at *f*. The sides of the excavation are represented in the drawing in the form of a large parabola, which in my opinion is the best position to resist the pressure of earth, increasing in weight as it arrives nearer to the bottom, and diminishing towards the surface of the ground. This form has been long verified by results, as every slight slip of

earth in a clay cut, where the slopes are finished off in an uniform straight line, naturally produces the very form of the curve here shown, which is a positive proof of its correctness. It may be quite as easily finished off in this form as in a straight line, by having a templet formed to the curve with a plummet attached to it, to direct the workmen in dressing it down.

Fig. 2 represents a longitudinal section of the same part of the excavation as fig. 1, showing the same strata of alternate beds of sand and clay marked *a a* and *b b*, together with the down drains *fff*: these down drains are placed at a distance of 60 feet apart, or according to the rise and fall of the longitudinal strata of sand in the slope, and they must be cut down to the bottom of the others, as shown at *f* in Fig. 1. To ascertain the expense of such drains, supposing they may average 3 feet deep and 2 feet wide, with clay puddle, and taking them as shown on the drawing, that is, two horizontal, and the others vertical, and the side of the cut at a slope of 1½ to 1, which will be found quite sufficient, being perfectly secure from slips when so drained, and compared with the expense of laying the slopes back at an angle of 2 to 1 with no draining, the following result will be obtained :—

	£	s.	d.
Additional land required between the slopes being 1½ to 1 with drainage, and 2 to 1 with no drainage, will be, computing one yard in length for both sides, 8 yards, valued at 8*d.* per square yard . .	0	5	4
Additional cost of excavation between slopes of 2 to 1 and 1½ to 1, one yard in length, is 32 * cubic yards, at 1*s.* per cube yard	1	12	0
	£1	17	4
Deduct two side drains and one down drain for 60 feet, is 142 feet, at 3*s.* per lineal yard, gives £7 2*s.*, or, per lineal yard of railway	0	7	1
Difference	£1	10	3

Thus a saving of £1 10*s.* 3*d.* per lineal yard, or £2662 per mile is effected in favour of draining, considering that both sides of the cut will take the same expense, which will not be the case, as the right-hand side of it will not take more than one half for drainage; while the excavation will be nearly the same, and then even the slope of 2 to 1 will not prevent slips from taking place without drainage.

Fig. 3 also represents a longitudinal section of an excavation in clay, showing a method of draining which has been adopted with considerable success. I may mention one instance in particular amongst many, which will perhaps suffice to show the utility of such drainage. The slope to which I allude is on the southern bank of the river Tyne, near Newcastle, where one side of the cut is open to the river, while the other is sloped back at an angle of 1½ to 1. This slope, which is 100 feet in perpendicular height, was drained in the manner shown with rubble stones, covered over with soil, and sown with rye grass and clover, since which time up to the present a space of five years has elapsed, during which not one single slip has occurred, the entire slope being now covered with a beautiful greensward. The drains here shown at *a a a* and *b b b* are put in at a depth of 3 feet 6 inches by 2 feet wide, and filled with rubble stones to within a few inches of the surface, the whole being soiled over to the thickness of 4 inches, and sown with grass seeds.

Fig. 4 shows a cross section of the last cutting without draining, and after the slips have taken place; the original face of the cutting being represented by the dotted lines *b c* and *d e*, is laid back at an inclination of 1½ to 1, which will be found quite sufficient with such a system of draining as represented and explained at Fig. 3. In this way an unflinching surface may be insured, capable of being exposed to every change of weather, and to every action of moisture, except that of water from behind, which, in the clay cutting, cannot penetrate in any considerable quantity. Even supposing that some thin beds of porous strata should exist in the adjoining field, the water from these will ooze out, and find its own level by means of the drain on the slope, if not previously carried off the land with underdraining by the occupier, so that this cannot in the least affect the cutting here described. Adopting, therefore, the supposition that the slopes cannot stand at the angle shown by the dotted line *b c* without drainage, it will be found necessary still further to extend the cutting to the dotted line *a c*, which is at an angle of 2 to 1, and allowing that the stability of the slope is thus secured by so doing, which is very much to be doubted, the next question that arises will be the difference of cost between the two modes of proceeding, and this may be ascertained as follows :—

	£	s.	d.
Additional land required between the two different inclinations of the slopes, and 1 yard in length, is 8 square yards, which at 8*d.* per square yard, is .	0	5	4
Additional excavation on both sides of the cut caused by the greater inclination of 2 to 1, one yard in length, will be 32 cube yards, at 1*s.* per cube yard	1	12	0
	£1	17	4
Deduct the side drains, &c., as shown on each slope in 60 feet in length, being 152 lineal feet at 3*s.* 6*d.* per yard, which amounts to £8 17*s.*, or 8*s.* 10*d.* per lineal yard of railway	0	8	10
	£1	8	6

making a clear saving of £1 8*s.* 6*d.* per lineal yard, or £2508 per mile of excavation in favour of draining in this instance. My opinion, supported by actual experiments on the method of draining proposed, decidedly is that with the depth of cutting shown, slopes of 1½ to 1 are greatly superior to no drainage and slopes in the same cutting, at a ratio of 2 to 1, because the latter have a much greater liability to slip, from the causes before enumerated.

In all similar cuttings through clay, sand, and gravel, or even clay intermixed with sand, not being in regular beds, but what is generally denominated sandy clay, a system of drainage ought to be pursued similar to those referred to, as no degree of sloping, however great, even as far as 3 and 4 to 1, will effectually prevent slips. The railway gutters are frequently filled up by slips in excavations, as long as the sides remain full of water, fed by the adjoining lands; or even by heavy falls of snow remaining for some time on those flat slopes, which naturally absorb it, and form almost a receptacle for retaining water, instead of being the means of discharging it quickly. This is a directly injurious consequence of flat slopes; and taking this with the foregoing results into con-

* Mr. Storey has here assumed a cutting of 24 feet in depth. This may be taken as a fair average; but of course in deeper cuts the saving would be greater, and less in those which are not so deep.—Ed.

sideration, I find no difficulty in arriving at the following conclusions: that with properly executed drains on the sides of the cuts, no slope, however deep the excavation, has occasion to be more than 1¼, or 2 to 1 at most, and that all further extension of them constitutes only a wilful waste both of money and time. The greater quantity of land required in consequence of the slopes being made at a greater obliquity, is alone a serious consideration, as it is always bought by the railway proprietors at double the amount it is really worth, and this of course is a still further waste of capital; and I am of opinion that all such extra outlay may with safety be dispensed with, as it not only creates an useless expenditure, but actually retards the progress of the works, and answers no useful purpose whatever: such proceedings in the making of railways I must say are wretchedly bad, both in the principle and plan, and still further bad in the execution.

Fig. 5 represents the cross section of a railway embankment consisting of clay formation, which is made up to its required height in dry weather, and frequently put hastily together in large lumps; under such circumstances, if a due allowance is not made for shrinkage, and also a greater breadth of formation at the top of the embankment than that required for the finished line of railway, the embankment, after it becomes consolidated, instead of being in the form represented in the figure A B C D, will assume the form shewn by the dotted lines of A *b c* D, as the embankment is not only reduced in height but is also compressed in width at the top and sides, which may be easily foreseen, by the consolidation of the whole into a compact body. In consequence of this a further addition to the embankment is required, and it must be again carried up to the required height and width, as shown at B C, which new spoil will thus overlap the previous embankment in the form shewn by the addition being lighter shaded, and from its position will be placed in the very worst manner it possibly can be, ready to slip with the very first casualty that may occur; and those slips will go down to the previous formation, where they will probably stop, as the upper stratum is not incorporated with the mass of the bank. Thus, however, repeated slips will occur for a considerable period, as may be seen at this very time on some railways in this neighbourhood where the embankments are not considerable. This effect is entirely owing to the causes here pointed out, and could easily be avoided by carrying on the embankment at a greater width than is required, making a sufficient allowance for shrinking, according to the state of the material used, whether consisting of clay, sand, or gravel; but as no general rule can be laid down to direct what allowance will be necessary, this must be entirely regulated by the practice of the resident engineer, duly considering such materials, whose directions on these occasions should be guided by his former experience in such matters. At the same time I must state, that the management of this matter is too frequently left to the young and inexperienced residents who have scarcely ever been on a railway, being first placed there by their tutor or chief engineer after going through the routine of his office. Having there completed his education on paper, the pupil is launched out as a paragon of brightness, ready, if not able, to undertake the working department of railway-making in any situation, however difficult to accomplish; while those of older standing and superior knowledge must shrink back, and give place to the superior recommendations given by their preceptor to the junior assistants. It is strange that all this is readily acquiesced in by the Board of Directors, however great the sacrifice may be to the shareholders generally, who commonly are only aware, when it is too late, of the effects of such misplacement.

Fig. 6 also represents the cross section of an embankment consisting chiefly of wet clay formed at different portions of time; the first portion being carried up to the line *a a*, through the valley where it may be proposed, after it is properly consolidated, must be formed to the required width at this point of the embankment before any additional material is again added. But before commencing another height it will be advisable to cover the whole surface of the embankment shown at *a a*, with branches of trees laid across the same, if procurable, or long thorns, ling, furze, brambles, or any kind of binding substance, the full length and breadth of the deepest part of the embankment; which will be a great check against spreading out by the accumulated weight of material so deposited to raise it to the required height. After this process has been completed, and another "lift," as it is commonly termed, is being carried to the height shown at *b b*, which is again allowed to consolidate as before, by carrying the same forward to the full extent, then again another covering of the same material as the former must be laid across the battery in its deepest parts only, as the pressure at this point becomes considerably less than where the first covering took place. When this is completed, the remaining portion of the embankment may be finished off to the full height required by the engineer, leaving a due allowance for shrinkage along the whole line according to its deepness, and may be finally finished off at a slope of 1¼ to 1; which is generally less than is allowed for embankments of this extent, and which certainly would be too steep, had not the precautionary measures been used of binding it in the manner already described. Two courses of thorns, &c. used in this way will not only effect a saving of material in forming the embankment, but will also act as a drainage to the same; thus effecting the double purpose of a saving of land as well as money, both of which must in all cases be a great desideratum in the economy of railway construction.

The expense saved by this method of making embankments may be ascertained by calculating the quantity of earth necessary to make the slopes of the embankment 2 to 1, instead of 1¼ to 1 as shown, and also the value of the extra land required for the top of the excavation and base of the embankment, as shown on the diagram by the part shaded *f e g h* and the dotted lines *d e g i*; and their amount compared with the expense of covering the embankment twice with branches of trees, thorns, &c. to the thickness of a few inches when compressed; the difference of which will shew the advantages resulting from the latter, and may be stated as follows; viz.:—

	£	s.	d.
Additional land required by the slopes being 2 to 1 both in the excavating and embankment, 28 yards in breadth by one in length, and 8*d.* per square yard is	0	18	8
Additional excavation required per yard in length of embankment to make up the difference of slope 30 cube yards, at 1*s.* per cube yard, is, . .	1	10	0
	£2	8	8
Deduct the covering of 60 yards in breadth and 1 in length of embankment at the 2 heights, with 4 cart loads of thorns, &c. at 10*s.* per load . .	2	0	0
	£0	8	8

This will be a saving to the Railway Company of 8*s*. 8*d*. per lineal yard of embankment, or £762 13*s*. 4*d*. per mile, which is not less worthy the attention of engineers in their future operations in railway making, than the efficiency of the slopes of embankments after such treatment has been practised.

In conclusion I have to remark, that when the slopes of the excavations are properly drained, no fear need be anticipated from soiling or sodding the same; as it is only where the slopes contain water that the turfing becomes an injury instead of good; preventing instead of accelerating the water drainage from out of the slopes, and retarding for a time its free course, until the weight of pressure accumulates so much, that the turfing and soil no longer can resist it, when it begins to show itself by swelling out on the surface, and thus giving a proper indication of what may be expected to follow if not immediately attended to, and foreboding the serious consequences that may be fully expected, as a fall, at least, can be scarcely avoided. Under these circumstances nothing will remain but to cut open drains to allow the water its free scope, which may prevent a serious slip at the time, until a further and more complete drainage can be effected, and thus finally the slope be finally secured, and the railway saved from such disastrous consequences as those which have already too often taken place. If the drainage be not attended to, all those serious occurrences which have taken place on railways from slips of earth, both in the excavations and on the embankments, must and will occur in future. A regular system of draining should therefore be devised by the engineer, whose particular attention ought to be directed, not only to the cases pointed out, but to every instance where water is anticipated in the line of railway, such as the seats of embankments in valleys pregnant with water, on the sides of hills, and especially in crossing deep ravines where water abounds. All these should command the most searching investigation, and be it remembered that any expense judiciously laid out in the commencement of railways, will amply repay the shareholders, and will be far preferable to the injudicious system of allowing the stagnant water to remain in a state capable of exerting its future evil influence in the destruction of the works. If the proper opportunity for effecting the drainage is allowed to pass, the certain consequence in the end will be an expense far exceeding that for which it might have been easily accomplished at the beginning, while many unforeseen disasters may take place before the drainage can be effected.

I remain, sir, your obedient servant,

JOHN STOREY.

PHYSICAL GEOGRAPHY VALUABLE TO ALL, BUT MORE PARTICULARLY TO THE CONSTRUCTIVE PROFESSIONS.

BOOKS OF TOPOGRAPHY—THEIR DESCRIPTIONS OF THE FACE OF A COUNTRY ONLY OF TEMPORARY VALUE—CHANGES IN THE ASPECT OF COUNTRIES, CREATED BY CANALS AND OTHER PUBLIC WORKS, AND BY MINING OPERATIONS.

THROUGHOUT the whole range of English literature, there is probably no class of works to which so many objections may reasonably be taken on the score of their design and execution as to that mass of Guides, Tourist's Handbooks, and Itineraries, or by whatever other name they are known, which compose the mass of our topographical literature.

It is indeed a reproach to the genius of our country, that while English works of fiction and imagination have deluged both hemispheres, while every branch of physics and ethics and religion has been, and still continues to be, ably and successfully treated, while books of travels through other countries, even the most wild and barren and forbidding, have not been wanting, the knowledge of our own country—far more important, more useful, more interesting than all others in the world—has to be searched for amidst a pile of dry, withering, and useless lumber, which indicates, in terms that cannot be mistaken, the tortured labours of the too often empty automaton, called a bookmaker—the paid hack of a bookseller, and the miserable victim of his own want of energy, of useful education, and of common ability.

The taste for beautiful scenery is one which elevates the soul, and fixes in the mind images of purity and grace and elegance, very much at variance with the hideous forms of vice which cross our path at every step, amidst the herds of men and of the living world. Therefore it is that the lover of nature, and the admirer of her beauties, in common with the listless wearied traveller seeking a relief from the cares and anxieties which haunt him in cities and in crowds, owes something of gratitude to the writer who tells him of the choice and exquisite scenes of nature's loveliness, amidst which his imagination may revel in full luxuriance, while all the external senses are filled with a measure of delight and beauty, which no artificial pleasure can impart.

But mark the transitory value of all descriptions of scenery which the most eloquent pen can draw. To-day the stately forest crowns the overhanging precipice with its monarchs of ancient growth, whose sturdy limbs have braved the lightning and the whirlwind through more centuries than the noblest empire under the sun has occupied in its rise from childhood to old age, with its moss-grown trunks, its branching foliage, and its glorious lights and shades—to-morrow comes the axe of the woodman to destroy all that was most beautiful in nature, and without one thought upon the loveliness he mars, upon the sighs of artists, sketchers, tourists, and of every man, woman, and child of the sentimental order, who had known it in its days of glory, down comes one stately inhabitant of the forest after another, till all is swept away that was once so famed in the memory, in the song, or on the canvass.

To-day the sparkling rivulet dashes from its hidden cleft in the rock, and furiously tumbles in spray and foam, as if eager to escape from the place of its birth, till, stopped in its onward course, it swells into the broad and glassy lake, and issues forth no longer the tiny rivulet, but the strong and headlong stream, meandering through the fertile vale to which it gives a name, and swelling at length into the noble river whose bosom bears about the stores of wealth which busy and restless man sends ever forth upon it. To-morrow the eagle eye of the engineer sweeps over the mountain pass in which the river and the valley together take their rise. The place at which that river sends forth its waters into the ocean, is a thriving and commercial port, and must be connected with the manufacturing district beyond those distant hills. Away then with the slumber and repose of nature—the peaceful sides of the valley re-echo the blast of the miner's powder, as one jutting prominence after another of the ancient time-worn rock is rent down, torn from

its bed, and hurled into the bosom of the stream below—away with those mimic cataracts, away with the glassy lake, with the silver streamlet, its hanging woods, and toppling precipice: the stream must be turned, its course must be straightened, its bed must be lowered, the lake must be drained, the lofty summit of solid rock must be bored and pierced through with as little ceremony and apparently with as little difficulty as a huge cheese, and in two dozen or so of moons from the commencement of these ravages amidst the paradise of nature, the barge of commerce is slowly and steadily tracked along the canal, which now usurps the place of all that the guide book of five years ago described as most lovely and most worthy of visiting. There it is, the pride and glory of commerce, with its muddy waters, its banks of stiff and solid clay, its reaches of smooth and level water, its locks like the steps of stairs, ascending to the lofty summit, its dark bold tunnel pierced through that summit, its ponds, its reservoirs, its wharfs, its walls, and its bridges, how different are all these from the scene which the painter delighted to dwell upon, the tourist delighted to describe, and the traveller delighted to turn aside from his path to gaze upon!

To-day some peaceful Cambrian vale, sheltered by dark and frowning mountains, is chequered by its neat white-washed farm houses; its sheep are tended by the hardy natives, and the primitive mill, driven by the rushing stream, gives forth almost the only artificial sound which mingles with the native immemorial echoes of the place. Such a scene has often been described, with many exquisite accompaniments, to which our pen could very feebly do justice, and many such an one existed a few years ago in South Wales; but mark the ravages which the advancing spirit of adventure has there wrought on every side. The valley is known to contain valuable seams of coal and iron-stone, and one greedy speculator after another strides over the land where the husbandman so long has toiled, and, calling it his own, commands his shafts to be sunk and adits to be driven, railways to be laid down, roads to be made, houses, furnaces, and forges to be erected; and soon the great monster steam is heard at his ponderous labour—huge wheels revolve, machinery dashes on impelled by irresistible force, rocks are shattered, millions of tons of solid earth are dragged from great depths beneath the surface, and tumbled without ceremony into the river which waters the valley. The river, left to find its own course, abandons in many places its ancient channel, and driven over new lands, fed by increasing supplies from its source, forces a passage in some new direction. Huge mountains of shale and clay arise; these are rivalled by huge mountains of cinders from the furnaces; the steam engines blow, and puff, and screach; machinery rolls, and rattles, and thunders; discordant voices yell above all other sounds; red-hot bars and pouring molten metal are seen around on every side, and the whole place, which was once a paradise, almost realizes the fables related of the infernal regions.

COMPLAINTS ABOUT THE DESTRUCTION OF SCENERY, AND THE SUBSTITUTION OF MANUFACTURING ARTS FOR THOSE PURELY AGRICULTURAL—CHILDISH NATURE OF SUCH COMPLAINTS—METHOD BY WHICH THE ENGINEER AND THE ARCHITECT OPERATE TO ADAPT THE EARTH FOR THE HABITATION OF MAN—SPIRIT OF ADVENTURE AND SPECULATION SHOULD BE ENCOURAGED.

Do we complain of these changes?—do we venture for one moment to place in competition all that is most ravishing to the senses, as a mere picture, with those grand adaptations of the earth, and her natural resources, to which we have alluded in the case of districts intersected by lines of internal communication, and explored by the miner on account of the mineral wealth which they contain? Such complaints would be childish in the extreme; they would be far too sentimental for the age in which we live, and would be utterly unworthy of any who consider the true sources of national prosperity, or of social comfort and advancement.

The wildest ravings of the most frantic madman in Bedlam are not more insane than the enthusiastic dreams of some, who waste their life in complaints of the encroachments which art and commerce are making upon the domain of nature and barbarism. Behold the refined, and delicate, and sensitive being, who shrinks from the contact, and almost from the name, of all that is useful, and looks with supreme contempt upon the busy industry of his fellow-mortals. Let such a being ask himself to what he owes the countless comforts and blessings which surround him; nay, even to what he owes the power of clothing his ideas in the refined and elegant language which he employs. To what does he owe that very distinction among the grades of society, which marks and fixes his own position? Does he owe these to his own exertions, or to those of drones, and murmurers, and exquisites, like himself? Or, rather, does he not owe them all, even from the highest luxury, moral, intellectual, or physical, which he possesses—down to the very birthright he inherits—to that leviathan spirit of advancement, which, in its broadest sense—a sense from which the cultivation of the soil is by no means to be excluded—may be classed under the head of commercial enterprize?

The tortoise challenging the antelope to a trial of speed—the insect defying the elephant—the farthing rushlight flouting the beams of the noon-day sun, are not more absurd or ridiculous ideas, than that of the man who prates of the beauty and simplicity of the patriarchal state, and dreams that such a condition could or should exist in a country teeming with an ardent, energetic population. In the constant increase of human inhabitants, which, in every successive century, the earth exhibits on its surface, we mark the hand of Providence; and then the charge is committed to man, of unceasingly adapting the earth to supply the necessaries, the comforts, and the luxuries of life, to this incessant increase of inhabitants.

Will the delicate and sensitive being, who shudders at the mention of a steam engine or spinning machine, step in between mankind and the obvious designs of his Creator, and draw a limit to the production of the human species? This he will confess beyond his grasp. What then?—will he show the increasing millions of human beings how they are to sit down in families, with their separate allotments of land, and revive in modern times the glories of the patriarchal age? Why, to support a people in this state would require a hundred, or perhaps a thousand times the extent of territory which any civilized country possesses for the use of its inhabitants.

Then away with such idle and fanciful dreams. The world knows best what is good, and fitting, and proper for itself—at least the mass of its inhabitants knows this—and they will not brook instruction from the man who, wrapping himself up in the mantle of his own conceit and ignorance, fancies himself an oracle, and stultifies himself by despising the useful and industrious classes of his own species.

We hope to be pardoned for this long digression, because it all bears upon the great subject of adapting the earth to supply the necessities and comforts required by her inhabitants. For this the

architect has reared, in all ages, the venerable temple, the lofty palace, and the stately mansion; for this the engineer tracks over hill, dale, and champaign, the line of the rapid railway or the slow canal, and covers the face of the country with noble aqueducts, and docks, and bridges—defying the force of wind and wave, carries out mighty moles or masses of masonry far into the sea—throws bridges across the greatest rivers and estuaries—and penetrates the most elevated summits of country by tunnels many hundred feet beneath the surface of the ground—and even, occasionally, forces a passage and carries a road of communication beneath the bed of a mighty river,* bearing on its waters the commerce of half the world.

We are confident of the support and approbation of most of our readers, when we venture to hold up to contempt and ridicule those persons who are so perfectly insane as to quarrel with the spirit and enterprize which have marked the progress of the most civilized countries of Europe. We do hope that these remarks may meet the eye of some such persons, and we beg them to reflect, that the very circumstances which give them the power of complaint, and assign to them a position in society which they no doubt value as it deserves, and enable them to draw a distinction between their own sphere and that of utility, and to look down upon the latter with most ungenerous, ungrateful, and unworthy contempt, have all been created by that spirit which they would seek to destroy, or at least to curb. All this is most unwise. Let adventure and speculation have their full sway—the energies of the individual never suffer from healthy exercise, no more will the energies of a nation suffer from employment. It is idleness, which as often proves the curse of states as individuals. Destroy, then, this serpent from the path, and all the avenues to glory and prosperity are open before a country, as surely as they are before the individual who first arouses from his dream of torpor, and manfully resolves to go on in his career, trampling upon obstacles, laughing at difficulties, and triumphing over all that would oppose him.

ANTIQUARIAN RESEARCH NOT FITTED FOR WORKS ON TOPOGRAPHY—THE WORK PUBLISHED BY MESSRS. HOW AND PARSONS, ENTITLED ENGLAND IN THE NINETEENTH CENTURY—INFLUENCE OF GEOGRAPHICAL POSITION IN DETERMINING THE SEATS OF MANUFACTURE—ILLUSTRATIONS OF THIS—IRON AND STEEL WORKS—GLASS—COUNCIL OF THE INSTITUTION OF CIVIL ENGINEERS ENCOURAGING THE STUDY OF PHYSICAL GEOGRAPHY.

Another great fault in topographical works is, that they are too much encumbered with antiquarian research. Now, there are few readers of such books who care one fig who lived at this old hall or that old manor-house a hundred years, or two or three hundred years ago. No person cares about the stupid old chronicles of all the old families in the country, their pedigree, and a hundred other things which are so industriously collected from the family archives. The reason is obvious enough why such things find their way into books of topography; the country gentry are commonly subscribers for copies to a considerable extent, and it is thought proper out of compliment to them to give a great many particulars about their ancestors, although every body knows that these particulars are of no interest whatever to the rest of the world. All this is far from being right—if the ancestral glories of the squirearchy must be chronicled in modern books, let it be done separately in works specially devoted to their use, and not mixed up with the natural history of the country, which, if compiled as it ought to be, would be generally interesting to all classes of society. Antiquarian research in topography is certainly very valuable when it throws light upon the rise and progress of a district distinguished by important manufactures, or by a high state of cultivation; and also when it affords some clue to the backward condition in these particulars for which other districts are remarkable. It is, however, to be regretted that the research of topographers is not often directed to any thing so useful as this, and even if it were, the difficulties of arriving at sound conclusions would be very great; unless the facts and the aspects presented at different periods were judged of by men of sound acquirements and great experience. Taking into consideration the difficulties of presenting a faithful picture of what any given district anciently was with respect to its natural and artificial productions, it would seem that the time bestowed in collecting information of this kind would be better employed in making more perfect its history at the time of writing the account, for after all it is the history of a place or of a country at the time present with which we are mostly concerned, and which we have most need thoroughly to understand.

We have therefore great pleasure in pointing the attention of our readers to a modern book on topography, which agrees remarkably with the conditions here indicated. We allude to the work now being published in parts by How and Parsons, entitled "England in the Nineteenth Century." Looking at the prospectus of this book, we were certainly not prepared to find it the herald of contents so valuable to the professions in whose service we ourselves are engaged. There is so much about depicting and about pictorial embellishment, that we expected to find it a common-place guide book on rather a large scale, with something of the flashy character of a picture book about it. In all this we are agreeably mistaken; and we have great pleasure in stating, that the professions made in the following extract from the prospectus have been most ably carried out in the numbers of the work before us: "The mechanical inventions used in our manufactories—the result of consummate ingenuity and great practical experience united, will be accurately described, and so illustrated by the graver as to bring their construction within the grasp of the plainest comprehension. The mode of operation will be shown by which they produce those astonishing effects which have contributed so largely to the national opulence. Among these are the carding machine, and the mule used in the cotton fabrication—the wonderful machines of the iron founders, with their giant powers of rending, compressing, or laminating the most refractory materials—the plastic skill displayed in the potteries, where the fine arts unite with the mechanical to satisfy the demands of the taste that fluctuates continually, and of the wealth that sets no limits to self-gratification; then there are the countless products of our large manufacturing towns, contributing to the comforts, elegancies, and luxurious demands of a rich and mighty people—these interesting topics are all connected with the present design."

In compliance with these intentions the Parts before us, seven in number, comprising the history of Lancashire, contain an admirable account of spinning machinery, and of all the processes employed in the cotton manufacture, from the pen, we believe, of Dr. W. C. Taylor; in addition to which the third Part opens with a

* The Thames tunnel is now driven across the river. A tunnel is projected under the Mersey, near Liverpool; and some years ago a tunnel was driven half way across the Severn, a few miles below Newnham, but abandoned on account of an irruption of water.

description, by no means inferior, of the manufacture of plate glass at the great works of Ravenhead, near St. Helens. The woodcuts accompanying these descriptions are highly useful in explaining the different processes, and the tools and machinery employed.

It is thus then that the most valuable and instructive picture of a country is to be given; we see it here as it really is, with its splendid triumphs of human skill and genius exhibiting themselves in our own times, and within the reach of our own observation. If it be required to go back to the ancient history of the districts where these and other manufactures have now attained so much superiority, and to study the birth and incipient growth of those things which have now reached a maturity so strong and vigorous, it may be sought in books of the date to which we wish to carry back our investigations. Certainly the most fitting and becoming labour for the writers of all works like the one before us is, that of faithfully describing the present condition of the country in all its natural and artificial features. At the same time it is by no means uninstructive to reflect upon the natural advantages which have given an impress, a bias, and direction in particular channels to the industry of a given district, because we are thus led to consider the application which may be made of similar advantages in other districts where they are entirely neglected or feebly acted upon. If we look to those parts of the country celebrated for any great branch of national industry, as for instance the coal and iron fields, the seats of our copper works, of the fabrication of steel, and of the manufacture of cotton and woollen goods, we find in them all peculiar circumstances of geographical position which have aided in developing the industrial arts for which they have become celebrated. Among the most striking instances of the command which geographical position exercises in this way, is that to which Mr. De la Beche alludes in the case of the copper smelting works of Swansea and the neighbouring places in South Wales. Such is the advantage given to this locality by its proximity to the inexhaustible treasures of the Glamorganshire coal field, that not only are most of the ores raised in Cornwall and Ireland brought to the smelting furnaces near Swansea, but even those from Cuba and from the shores of South America are carried more than 4000 miles across the Atlantic to be smelted with the coal of South Wales.

The geographical position of the flux, with respect to the locality where iron is found, is a highly important consideration. Some ores—as the argillaceous carbonate, which so extensively prevails in the South Wales field—require lime as a flux; while others—as the rich hepatic ore of the forest of Dean, and of Lancashire—contain too much lime, and require, in the furnace, either a mixture with clay, or with an argillaceous iron-stone. It is well known that the true coal formation always rests in a basin of limestone, from which, at some works, the stone can be conveniently procured within the distance of a few miles. Some of the works at Merthyr Tydvil are thus favourably situated, but in others, in preference to an expensive land carriage of limestone, the ore from the Forest of Dean, and from Ulverston in Lancashire, is extensively transported into Wales, to be mixed with the native carbonate. In ignorance of this fact, the visitor of the iron works of Merthyr Tydvil, Dowlais, Pendarron, and the neighbourhood, would be surprised to witness heavy barges passing up the canal into the country, laden with the raw iron ore (or with mine, as it is more commonly called), and huge waggons laden with the same materials, drawn up by locomotives amongst the hills, to the works of Dowlais, to be there smelted with the native ore, and sent forth in the shape of iron to every corner of the earth. An opposite anomaly, arising from the same necessity for mixing together the ores from distant places, will be witnessed on the tramways of the Forest of Dean, and at the small harbours of Lydney and Bullo Pill, which form the shipping places for the Forest, where large quantities of iron mine may be seen passing away from the furnaces in its immediate neighbourhood, and being shipped off to a distant locality, where its peculiar qualities are to be rendered of the highest value by mixture with other ores, which are deficient in those same properties by which these are distinguished. Before the introduction of pit coal for the smelting of iron, the rich forests of the weald of Sussex, and of Furness in Lancashire, peculiarly fitted these districts for the manufacture of the iron which was found in their respective localities. These ancient iron-works, long since abandoned, have given place to others on a far greater scale, in all of which the same effect of geographical distribution is exhibited, since all the iron-works are established in places favoured by immediate contiguity with extensive formations of coal. Sheffield, the great seat of the steel manufacture, is a striking instance of the value of geographical position. It enjoys the advantage of a continuous line of water-carriage from the shores of Sweden, where the iron bars are shipped for Hull, in order to be converted into steel; in addition to that of contiguity to an extensive coal-field, and the possession of abundant water-power for propelling the numerous kinds of machinery employed in the fabrication.

Recent improvements in the means of compressing peat, and discoveries of its value as a fuel for impregnating iron with carbon, by converting it into the blistered bar, which forms the first process in the manufacture of steel, would seem to point out many very poor and unimproveable districts in an agricultural point of view, as highly favourable for the sites of these important works. Such are many tracts of peaty land on the eastern coast, in Norfolk and Lincolnshire, which are approachable by water conveyance from the coast.

The most favourable sites for glass works will be those where a fine siliceous sand can be procured in abundance, and where an alkali is at hand, for effecting the fusion of the sand. The alkali is now commonly procured from the muriate of soda (common salt), and hence the advantage which the establishment at Ravenhead possesses over most of the others in England, from its proximity to the great salt-works of Cheshire, the neighbouring county.

Similar remarks apply to the seats of all the important manufactures of this country, and it is, therefore, not only highly interesting, but most useful at the same time, to have the geographical relations pointed out, in connexion with the scenes and circumstances of industrial enterprise, to whose creation they have so prominently contributed. Strongly impressed with the conviction, that physical geography and geology—for these two sciences are intimately connected—should form a standard branch of the engineer's education, and should receive more attention in this respect than they have hitherto commanded, we are led to observe, in conclusion, with great pleasure, that the following is one of the subjects announced for prizes by the Council of the Institution of Civil Engineers during the present session:—"On any of the principal rivers of the United Kingdom, describing their physical characteristics, and the engineering works upon them."

This opens a wide field of geographical research, and we cannot too highly recommend it to those who have leisure and capacity to embark in it.

AGRICULTURAL ENGINEERING.

TO THE EDITOR.

SIR,

I AM led by the observations of the writer of the article on "Agricultural Engineering" in your last Number, to beg a place for a few remarks. That writer very much mistakes the object I had in view, when I ventured to propose a system of relief-mapping as suggestive of agricultural improvements, if he supposes, as his remarks would imply, that I advocate its adoption in order to supply the engineer with more perfect *working drawings* than he already possesses in the plan and section. The branch of engineering termed agricultural at present exists only in theory, for, although the late Mr. Mudie and some others have laboured hard to bring the subject before the public, it remains as it was when they commenced their arguments, in spite of a general conviction of their truth. It was a consideration of this fact which induced me to turn my attention to relief-mapping, for I thought, as I do now, and as experience has proved, that by placing under the eye a reduced fac-simile of landed property, the agriculturist, uneducated in lines, dotted contours, and figures, perceives at once all the capabilities of an undulatory surface, with the same facility as the land itself would suggest, could he take a bird's eye view of it. With all deference to the opinion of the writer of the article in question, I cannot but believe that the great complication of lines shown in a contour map, serves rather to confuse the uninitiated mind than to convey, in a simple manner, the character of the surface they are intended to illustrate.

Models can now be made in electrotype, and being coloured with oil paint, may exhibit, in a very clear way, even to the farming labourer, all the qualifications of a contour map. A cistern of requisite depth, rendered water-tight, and capable of being set to a true level, should be made to fit the model, and up the sides of this cistern should be marked the scale of vertical height upon which the model was constructed, with the nonius on a level with the lowest spot of the estate; then, by pouring water into the cistern, those parts which are lower than others will be first covered, and true horizontals will be presented to the mind, in a manner closely allied to nature itself.

As to the expense of making a contour map, compared with the construction of a model, I have only to say, that if a survey of an estate can be made, the levels taken, the contours set out on the ground, and the work of the survey increased by taking up those contours, and representing them on the map, if all this can be done for 7*d.* an acre, I will guarantee a model of the same ground for 1*s.* 7*d.* an acre, for the modelling I find by experience can be done for a shilling an acre, and the data required for the representation of contours are all that is necessary for a relief map.

I am, &c.,

J. BAILEY DENTON.

9, *Gray's Inn Square.*

[We insert the preceding letter from Mr. Denton, because it is only fitting and proper that an opportunity should be afforded to him of explaining what he conceives to have been a misrepresentation by a writer in this Journal, of his system of model mapping, or at least of his intentions in proposing this system. At the same time we think it necessary to point out several particulars in which Mr. Denton's observations are very far from meeting with our concurrence. In the first place, we should be very sorry to allow that agricultural engineering exists only in theory, because it is by pointing to the successful effects already produced upon agriculture by processes which are confessedly of an engineering character, that we ourselves, with other labourers in the same field, mainly hope and expect, ere long, to arouse a general and lively interest amongst landed proprietors, to the immense importance of applying works of engineering to the improvement of the land. We may point to the general system of underdraining land—to the system of gaulting land, by throwing up a subsoil of stiff clay to mix with the light peat of the fens, and to the dressing of land with chalk procured from shafts sunk through the plastic clay in many parts of Hertfordshire and eastern Kent, as some few of the instances in which engineering works have been applied in agriculture. We should class these works with many others of greater magnitude, such as the drainage of the fens, the embankment of land against the sea and along the banks of rivers, and the system of warping or silting over newly recovered lands with soil, under the general head of agricultural engineering.

With respect to the superior intelligibility of models, on which Mr. Denton so strongly insists, we must leave the decision of this point to the landowners themselves, who are most interested in judging between them. To argue upon the comparative merit of either system in this respect, will not in any way alter those circumstances, on which depends the facility for understanding it; and, however the proposers of different systems may dispute amongst themselves about the superiority of their own favourite, it is public opinion alone which will at last determine to which the preference is to be given. On this subject we shall only add, that having spoken to several influential land-owners about the value of representing levels by means of contours, we found that, far from being unable to understand the meaning of the lines, they all expressed themselves both gratified and astonished at the perfect simplicity with which a net-work of levels could thus be laid down without the confusion of figures. It is paying a poor compliment to agriculturists generally, to say that they would be confused by anything so simple as a contour map, and we contend that where one might possibly be puzzled, and unable to comprehend its meaning, he should rather be taken as the exception than as a type of the class to which he belongs. Of course there are amongst farmers and land-owners, as well as in every other department of society, men distinguished by more than a due proportion of dulness and stupidity; and if people of this kind are to be singled out to prove the difficulty of understanding a contour map, we feel convinced for our own part that it would be just as difficult to teach them how to derive any useful information from a model as from a map. It is satisfactory, however, to reflect that the great body of agriculturists are daily increasing in intelligence, and we trust that the time is not far distant, when both models and contour maps will be as familiar to them as the ordinary plain maps of the land.

The other point we have to remark upon in Mr. Denton's letter, relates to the comparative expense of constructing a model, and that of furnishing a map with horizontal contours. Mr. Denton surely cannot suppose for a moment that the writer of the article to which he refers meant that both the original surveys of the land could be made, and the horizontal lines afterwards traced by levelling on the ground, for 7*d.* an acre. On the contrary, there is no more strenuous advocate than the writer of that article, for the

opinion that surveyors are at present working far below the real value of their services; and he would be strangely compromising his own sentiments if he were to contend that even a common survey and map of enclosed lands could be made in a proper manner for so low a price as 7*d.* an acre. Mr. Denton will find on referring to the article in question, that the price of 7*d.* an acre applies only to the levelling and setting out of the contours on the ground, and does not even include the transfer of these lines to the map. This latter, however, would be very readily done where a survey had been previously made, by marking the crossings of fences, and by other simple expedients, which will readily suggest themselves to the practical surveyor.—Ed.]

REVIEW.

A Treatise on the Application of Marine Surveying and Hydrometry to the Practice of Civil Engineering. By David Stevenson, C. E., Author of "The Civil Engineering of North America." Adam & Charles Black, Edinburgh; Longman & Co., and J. Weale, London.

A Treatise on the Improvement of the Navigation of Rivers, with a New Theory on the Cause of the Existence of Bars. By W. A. Brook, M. Inst. C. E. London: John Weale. 1841.

Proposed Embankment across the Old Estuary of the Nene Outfall. By Sir John Rennie.

Captain Josiah Needham Taylor, R. A. Patent Floating Breakwater. 1838.

An Essay on the Formation of Harbours of Refuge, the Improvement of Rivers and Sea Ports by Moored Floating Breakwaters. J. Weale. 1840. *With reference to the Patents of David Gordon, Esq. of* 1822, *Sir J. Bentham's Patent, and J. White's Patent of* 1824.

The acquisition of land in England from the overflowings of the sea and the inundations of land waters is evidently of early date, which not only appears from the ancient banks which exist in almost all the estuaries of our rivers, but more particularly from the striking language of the statute of Henry VIII., anno 1531, which has these expressions in the preamble: "That he, the king, considering the damages and losses sustained by the outrageous flowing of the waters of the sea in and upon marsh grounds and other low places, *heretofore by politick wisdom won and made profitable* for the Great Commonwealth of this Realm," hath ordained Commissioners of Sewers, &c.

The words "by politick wisdom won" necessarily imply that works had previously to that period been executed to no small extent; but the statute alluded to, confining itself to the maintenance and reformation of such works, gave no powers for new attempts at embankment or acquisition of land; and it hardly appears that until the great undertakings in the time of the Protectorate there were any considerable adventures projected with the view of enlarging the surface of the country, or of rescuing its existing overflown marshes. How greatly the country is indebted to those persons who devoted their talents, their wealth, and their efforts to these objects, is now demonstrated by the productiveness of the exceedingly valuable and fertile land which constitutes so great an appendage to the counties of Cambridge, Huntingdon, Lincoln, and Norfolk, instead of the flats which formerly existed, and which were morasses hardly passable, and sustaining little beyond wild fowl. An examination of the valuable work of Badislade and the writers on the fens will display the endeavours of the Undertakers, as they were called, of this period, who, nevertheless, confined themselves to the improvement and security of the land theretofore rescued from inundation, and did not obtain any further extension of surface.

The work of Mr. David Stevenson offers to the public the essential ground-work for regular surveys and soundings of waters, which in themselves constitute the only correct mode of forming a perfect judgment of the practicability and profit to be derived from any attempt at the improvement of rivers, or the embankment of their borders or estuaries, or on the shores of the sea. This work embraces much valuable information on the tidal wave, its peculiarities, variations, and effects; and shows how surveys are to be made and plotted, where natural impediments present obstacles difficult to be overcome, except by a well-considered arrangement of observations. His triangular system is in itself extremely judicious, liable to little error, and his mode of ascertaining soundings by ranges of temporary gauges fixed on the land, is particularly explanatory. His Field Book is extremely simple, and is calculated to prevent any errors in plotting,—a matter of serious difficulty, after the lapse of a period of time, when it becomes hardly possible to recur to the objects that have been noticed during the survey. At some seasons of the year and in uncertain weather it becomes necessary to seize all opportunities of taking measurements and making observations: these will therefore accumulate, and without such instructions as those which Mr. Stevenson has laid down, might generate errors which it would be very laborious to reconcile.

The consideration of Mr. Stevenson's work naturally leads us to the examination of that by Mr. Brook, concerning which so much controversy (between him and Captain Barrett) has already appeared before the public in various late publications. It is not necessary that we should undertake to decide upon the accuracy of localities, but the principle of forming harbours in bights or on promontory points is well worth discussion. The theory of bars had engaged attention before the time of Newton, and we learn from the Principia (No. 123, 361,) that wherever any eddy water occurs, which is charged with any substance heavier than the water itself, whatever may be the dimensions or specific gravity of the particles, they will produce a bar, sandbank, or mud, varying in form and density according to circumstances, and according to the actual ponderosity of these substances. We admit that the position or place of the eddy water will rarely or never constantly be the same, because the very bars, and sands, and mud deposited give different directions to the current of waters attempting to flow over or by them. Indeed, we know large deposits are sometimes rapidly made from great land inundations; and at other times the falling of a cliff, and the effects of a violent and continuing storm rolling shingle before it, produce actual impediments to navigable channels which have been theretofore freely used, and which had ample depth of water. We confess we do not quite understand what Mr. Brook calls, in his table of contents, a new theory on the causes of bars: he seems to refer their formation to an endeavour of the flowing tide up a river being defeated, which defeat causes it to yield the sand, or whatever may be suspended in its volume, as the deposit which constitutes the bar. Now, this is neither more nor

less than to say that wherever the motion of the water ceases, all matter which has been held in it obeys the law of its specific gravity; we cannot therefore call this a new theory.

On the artificial scouring of rivers his chapter is particularly short. On this head we believe that much may be done by so shortening the courses of the streams as to increase the velocity of their afflux into the ocean, as, indeed, has been practised by our late and existing engineers, so much so that the principle is fully understood; and it is only to be regretted that an object so desirable was impeded by the worse than idle opposition which existed to it when it was formerly proposed for the fens of Norfolk, Cambridgeshire, and Lincolnshire, as in the work of Badislade, before alluded to, and the valuable pamphlets of Mr. Edwards, Mr. Chapman, and Mr. Mylne, on the subject.

When we reflect upon the fact, that throughout the world the largest portions of productive land are alluvial, and that nature is constantly and sometimes not very slowly carrying forward the soil and vegetation of the uplands towards and into the ocean, it may not be foreign to our remarks to consider the extreme importance of well-digested information relative to the various levels of alluvial tracts on the borders of the sea wherever they occur; and perhaps we cannot do better than examine what the Italians have done and written on the subject, their writings and examples being particularly valuable, because the rivers rising in the Alps and Apennines have such various inclinations, and run over such different strata, that the regulation of their waters has given rise to very learned and important publications, and to experiments which, failing in many instances, and being productive of good in others, may all be considered as lessons of experience for those who will patiently study them. To refer to one example of the magnitude of the designs carried on in Italy, it is noticed in the Life of Leonardo da Vinci, that Ludovic Sforza employed him to cut a canal 200 miles long from Martisana to Milan, which project was partially accomplished only; and at this time it is said that the debouches of all the rivers of Lombardy, Tuscany, and the Papal States, are by the deposits of soil rendered unhealthy as well as unproductive, and are with great difficulty improvable, on account of the want of current which has formerly existed in the channels of their streams as they approach the sea.

We now advert to the report of Sir John Rennie, on the improvement of the great estuary of the Wash, between the coasts of Norfolk and Lincolnshire, by which it is proposed to recover 150,000 acres of valuable land.

This proposition has been some time before the public, having been submitted to a variety of gentlemen interested in carrying it forward as possessors of lands, by subscribing with others a very large sum of money. The great feature of the undertaking is, to unite by new channels the waters of the Ouse, the Nene, the Welland, and the Witham in one issue into the sea, to be made about midway between the Lincolnshire and the Norfolk shores, which issue having the accumulated waters of all these rivers confined by solid barrier banks, will deepen itself, and carry to seaward into the German Ocean all the deposits which now impede the navigation, and obstruct the ascending and descending tides, therefore superadding to the acquisition of the 150,000 acres before mentioned, the benefits to arise from deep channels to the fens of Lynn, Wisbeach, Spalding, and Boston.

The well-earned fame of the late Messrs. Rennie and Telford, from the execution of works in the level of the Wash, and the admirable science displayed by Sir John Rennie in other works since executed and in hand, lead us to lament that at a period like the present, when there is so much unemployed labour and attainable capital, it should not be expended in a work of this nature, which would doubtless add to our national greatness and wealth, and rival the far-famed acquisitions at the mouths of the Rhine, the Waal, the Scheldt, and the Meuse, on the opposite coast of the continent. It has been said that disagreements as to the possession of the soil, when acquired, and objections to the loss of coast frontage, as well as the difficulty of raising the necessary funds, have impeded the measure: we trust that England will not be so devoid of spirit as to suffer such motives to embarrass, or the want of means to prevent, the progress of a work so highly important and beneficial.

To criticise a little on the proposition, it may not, however, be unfair to remark, that as all the rivers falling into this estuary carry with them abundance of clay, sand, and some stones, these must eventually be deposited somewhere, consequently there will arise a fresh bank or island, more probably just where the tides and these waters become eddied, and we must infer that this bank will be in the nature of a delta, because, like all other deltas, there will be the same operating causes, viz., the force or current of the flowing tide will be one way, and the ebbing tide another. It may further be remarked, that as the subject is really a national one, it ought not to be dependent on private advances of money, but the matter in all its bearings should be well debated by a committee of persons unconnected as to property with the undertaking, who should weigh its positive merits, and submit such a plan as would meet the vested interests of the landholders, ascertain the advantages or injuries with respect to the towns to be affected by it, and especially examine if the perfect drainage of the uplands, already so much improved, may not be accomplished.

The barrier banks proposed by Sir John Rennie are considered to be an arrangement of timber perprestures across the stream, which, delaying the tides both upwards and downwards, lead to a deposit of silt and mud, which, continually increasing, warps up the bottom and its vegetable growth to such an extent, and with so much rapidity, as to effect what would not be accomplished by the labour of multitudes. These perprestures are open jetties: the first was originally made for the purpose of obtaining a landing place at North Lynn, and is mentioned in the little work which is now about to present itself to our notice. It will be proper to remark, that Sir John Rennie shows, by calculations, that there would be ample remuneration for the outlay of money, which would be progressively increasing. From the designs of this engineer, the Commissioners of the Nene Outfall have lately entered into a contract for the construction of an embankment 3¼ miles in length across the Cross Keys Wash*, which is to be of earth excavated from the ancient deposit, faced on the sea side with stone to the height of 12 feet above the highest tide, and with a slope on the land side of 2 to 1, which inclinations are nearly the same as those which have been adopted at the Lido, opposite to Venice, to restrain the incursions of the Adriatic.

This partial enclosure of land ought to lead to greater and more general attempts, and we shall hail with the most cordial applause the employment of our redundant labour, which has lately been so beneficially occupied in railway constructions, in works of this

* The plan, sections, and specifications of this embankment are published in the Journal for June last, No. 29.

nature; and we hope that such an employment will relieve a considerable portion of the agricultural population, which has been at a most unfortunate moment thrown upon the manufacturing districts.

Mr. White's essay on the Formation of Harbours of Refuge, embraces a variety of what he considers improvements on the modes generally in practice for the formation of harbours, and the regulation of the currents of rivers by floating, in the place of solid constructions; and if he can be borne out by the hypotheses he offers to the public, a great deal of benefit may arise from his experiments and lucubrations. We will endeavour to bring them forward, at the same time observing, that we apprehend he is endeavouring to accomplish great purposes, with means apparently too inadequate: the power of these means may, notwithstanding, be more operative than we estimate, and we think they deserve fair trials, because the value of them, and the probability of their general application, are sufficiently apparent.

We have transiently alluded to Captain Barrett's controversy with Mr. Brook, but we have perhaps passed over his main principle too superficially, which is, that promontories are the proper places for harbours, and that in no bights or bays where there are deposits of alluvial matter, ought they to be placed. We concur almost entirely in this view of Captain Barrett's, and we really believe all really good harbours ought to be free from back-waters, and that the expediency of scouring, on which so much money has been wasted at Dover and other places, is at least very questionable. The utility of Ramsgate in some measure displays the principle of a promontory harbour without back-water, but it does not come up to our ideas of a perfect harbour, either in accessibility or magnitude, nor does it offer the conditions of an isolated harbour, as described by the 1st Section of Mr. White's essay, for the entrance of every harbour of refuge is dangerously situated when it stands opposed to the most violent quarter of the wind, whereas a floating harbour, with deep water surrounding it, can be entered from the lee side.

As to the mode proposed by Mr. White for mooring his floating masses, we believe that doubts exist, and important ones, too, whether it will be practicable to maintain his chains without fouling, particularly of the lengths he recommends, because, from the sudden shiftings of the wind and the checks of the tide, his frames would not always go about all precisely together, and we consequently consider the maintenance of the forms he has laid down somewhat problematical.

We do not hesitate nevertheless to express our opinion, that there are many and great advantages derivable from the plan of laying down floating bodies, and we shall refer at the close of our observations to the patent breakwater of Captain Needham Taylor, and the endeavours of the company which has been established to carry out his propositions; and we cannot omit observing, that the large annual outlay on the breakwater at Plymouth, and its efficacy in preventing accumulations in the Lee, ought to induce a fair trial of any reasonable proposition to effect so important a measure as that of determining by actual experiment on an adequate scale whether any benefit which the founded breakwater affords may not be obtained by floating masses. As affording an example on a small scale, we confess ourselves surprised and gratified in observing the effects of the downward current on the floating booms laid down for protection of the coffer dams of Westminster Bridge, especially in turning the water in the direction required, and at the same time producing an almost perfect tranquility within the booms secured against the piers of the bridge, particularly on the south side at the middle piers.

The latter observation naturally leads us to the consideration of the second section of the book before us, referring to the improvement of rivers by moveable floating bodies, which is a subject perhaps of little less importance than the establishment of harbours of refuge: we believe that few materials have been placed before the public which throw any light upon the effects of subsidence in rivers produced by locks, rendering shallow the water above them by the deposits they cause in the body of the stream. It is said, and we believe truly, that the floods in the Thames above the recently constructed locks, lower down the river than Maidenhead Bridge, have greatly increased the heights of the floods, and made them much slower in retiring through their ordinary channels.

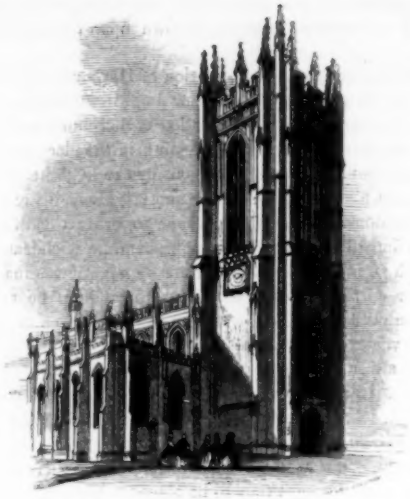
We shall now allude to Mr. White's plan on this subject, and it is manifest to us that the casual attendance on the floating logs and caissons which he suggests will, by the relaxations of the chains which secure them, permit the flood water to pass without impediment, and in this way will never cause any deposit at the bottom of the stream. The persons interested in the navigation of the Severn* have always regarded locks with great jealousy, and with reason, for a river of so much rapidity, and carrying with it so much alluvial matter, both solid and light, must create deposits wherever any artificial shoal or weir is allowed to exist. A weir does not suffer the escape of any thing underneath it, but a floating raft or caisson encourages the stream below it to deepen the bottom, and clear away the impediments which may already exist there. Probably there are few places in England which, on account of their locality, have attracted more attention than Dover, as to the improvement of the harbour, and the reports recently made to Government lead to an expectation that a vast sum of money will be expended at this place: the failure of every attempt hitherto made to create this place a harbour of refuge, ought to induce those who have the direction of the pecuniary means of the country, before embarking in any new enterprise, to consider well the schemes which have been presented. In attempting to restore Dover to an efficient harbour, the engineer is contending not in concert with, but in opposition to nature; and this great distinction cannot be too strenuously kept in mind when calculating in this or similar cases upon the probable success of his efforts. The falls of the cliffs westward of the harbour, have proved partially beneficial, by arresting the progress of the beach eastward; but we think, with Mr. White, that floating bodies would perform the desired object. As these can be shifted according to the loss of depth of water from the run of the shingle, which will, in spite of human effort, continue to accumulate somewhere, Captain Worthington, Captain Taylor, and Mr. White's proposals fairly call upon the authorities to try some experiments upon a sufficient scale to prove their power; and whether the fixed open timber work pier of Captain Worthington, the superficial frame, with its single chain, proposed by Mr. White, and which draws only from 4 to 6 feet water when the sea is tranquil, or whether the deep and elevated frame, patented by Captain Needham Taylor, is adopted for these experiments, we

* During every summer the water of the Severn from Gloucester towards the sea is continually turbid.

cannot but think the trial should be made at the public expense, and not at that of individuals.

We shall close our criticism with a few reflections on the idea of creating a new island in the mouth of the Thames, as suggested by Mr. White. We feel, that the immense body of retiring tide, carrying with it the rich agricultural manure of this vast Metropolis, floating continually in commixture with its waters, stirred up and expedited seaward by the numerous steam vessels impelled with great rapidity, ought to be induced, by artificial means, to make its deposit in a proper place. It is admitted, that the mud accumulates extensively in all the little creeks of the river wherever there is any increased breadth of its waters, the deposit injuring the drainage of the country, and benefitting little the surface of the land. We cannot help thinking that some well-arranged mode of irrigation, and some proper plan of converting this deposit into terra firma, is of easy accomplishment, not only in the Thames, but in all important rivers.

We will meet the objection that the formation of a north-west and south-west channel at the entrance of the river would be detrimental to navigation for want of expanse, by observing, that it is but few hours of the tide when the general flats or banks are safely to be sailed over, and that the tacking upon and among the numerous shoals as they now exist, is a very hazardous enterprise. We admit, however, that any changes in the direction of the tide may create other deposits where not at present existing, and that any creation of an island, as suggested by Mr. White, should, before its final adoption, be well considered in all its bearings with a true spirit of philosophy and with ample caution, contrasting the various benefits derivable, with the expence and hazard.



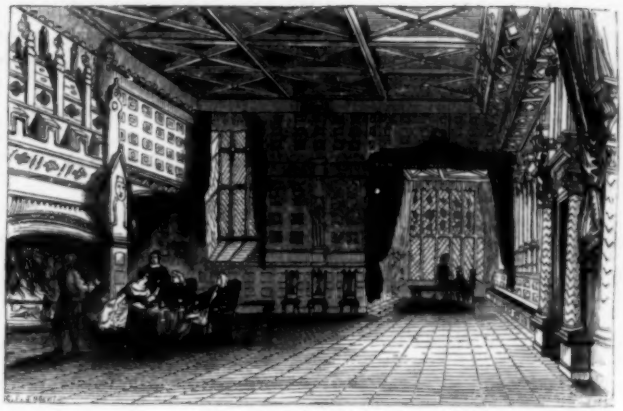
[Collegiate Church, Manchester.]

[Interior of Collegiate Church.]

England in the Nineteenth Century. London: How and Parsons, 1842.

We have already made favourable mention of this work in another part of the present Number, and our principal reason for introducing it again in this place is to present to the notice of our readers a few specimens of the architectural style of the work, and of the admirable wood-engravings by which this and other divisions are illustrated. The following descriptions refer to the engravings: "The Collegiate Church of Manchester ranks among the first of those ecclesiastical edifices which were erected when the florid style of our pointed architecture was in full development. Its date and style belong to the same class of religious structures as Bath Abbey Church, King's College Chapel, Cambridge, and others remarkable for airy and slender supports, and ornamental profusion, while it would puzzle the most fastidious to point out a disproportion in the one case, or indicate where a single attribute in the other could be omitted with advantage. The 'dim religious light' which seemed so carefully preserved in the edifices of the preceding ages, even in those of the early Saxon times, is here exchanged for 'day's garish eye' without stint. The delicacy of the ornaments, the slenderness of the columns, and the lightness of the groins and arches, which excite wonder, as in King's College, at the enormous weights they seem to suspend in the air, give this style a character of grace, and a delicacy quite feminine, contrasted with the Herculean masses and solid arches of our

earlier ecclesiastical structures. The Collegiate Church of Manchester then, belonging to this period of our architectural history, may compete with any of its class under its own peculiar plan. It is disadvantageously situated, amid the smoke of countless manufacturing volcanoes, in an atmosphere continually clouded, and built of a red soft stone, in its qualities of colour and duration unworthy of so beautiful a building. The sharpness of the angles, externally, is corroded by time, and miserably blackened, so that the aspect on the outside may not at first sight strike the unpractised eye with its excellence of proportion and elegance of design, though to individuals at all acquainted with the different 'orders,' if we may so speak, which exist in the religious edifices of England down to the date of this church, its merits must be at once apparent. It was begun by Lord de Warre in 1421; but it appears that the entire fabric was not worked out until 1485, and that considerable additions were made in the sixteenth century. Many alterations and additions are of recent origin. There are also numerous chapels in this church, all but one of which are private property. Upon entering, the admirable adjustment and symmetry of the parts are at once disclosed. From the nave, the impression which the architect designed to produce is complete, exhibiting great lightness, beauty, and even playfulness of design and execution. The columns sustain light arches constructed with great skill; the spandrils are ornamented with cinquefoil vaultings, containing shields of a dark colour, and the walls over them pierced with small windows of five lights; the roof is lofty, and highly decorated. From the capitals of the lower columns slender pillars shoot up, ornamented with trefoils, supporting half lengths of angels holding musical instruments. From the capitals of these a third row of columns rises from behind the angel-effigies, and sustains the roof. The choir is one of the most beautiful we have ever seen. The ceiling is flat, divided ornamentally into squares, and supported by light rafters, which at the terminations are sustained by angular buttresses rising between the windows, perforated laterally, and of a very elegant pattern and appearance. At the east end is a broad window, of seven divisions, filled with painted glass of modern date. The windows on both sides of the choir are more elaborately executed than those of the nave. The stalls are finely carved, and some of the panel work is wonderfully executed."



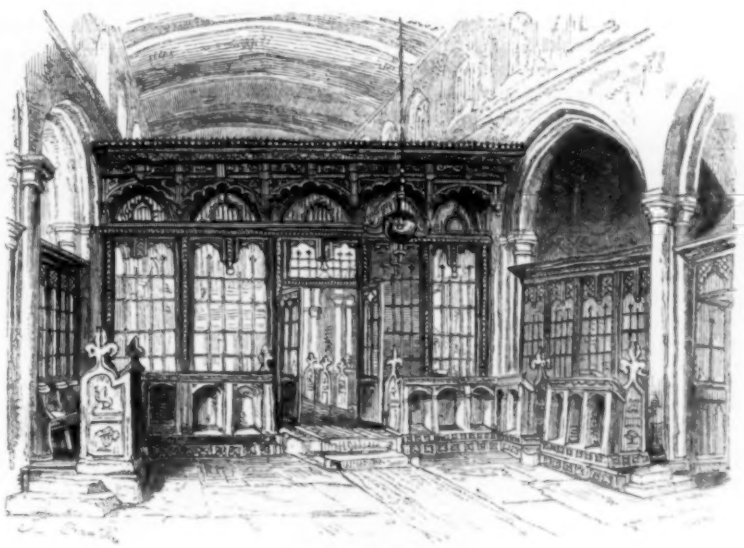
[Speke Hall.]

"SPEKE HALL.

In the parish of Childwall, near Liverpool, was built about 350 years ago, is surrounded by a ditch or moat, and possesses every trait interesting to the lover of antiquity. Gigantic yews shed their gloom over an antique court; the old hall is decorated with a wainscot mantel-piece, said to have been brought from Edinburgh castle after the victory at Flodden Field; and Sir William Norris brought here a part of the Scotch king's library from Holyrood House."

SEFTON CHURCH.

"Sefton is seven miles north from Liverpool, and is both a parish and manor, once belonging to the Molyneux family by inheritance from William de Moulin, an ancestor. The church is large and handsome, consisting of a nave, two aisles, and a tower, with a steeple, owing its erection to Anthony Molyneux, a rector here about the time of Henry VIII. This church is separated from the nave by a screen, and contains sixteen stalls, remarkably well executed in carved work, and ornamented with grotesque figures; and there is a fine carved canopy remaining over the pulpit, the workmanship of which is exceedingly beautiful, though much injured by time. Many of the Molyneux family are interred



[Interior of Sefton Church.]

in this church, which contains a number of fine monuments erected to different members of the family. The engraving is a faithful representation of a part of the interior of this edifice."

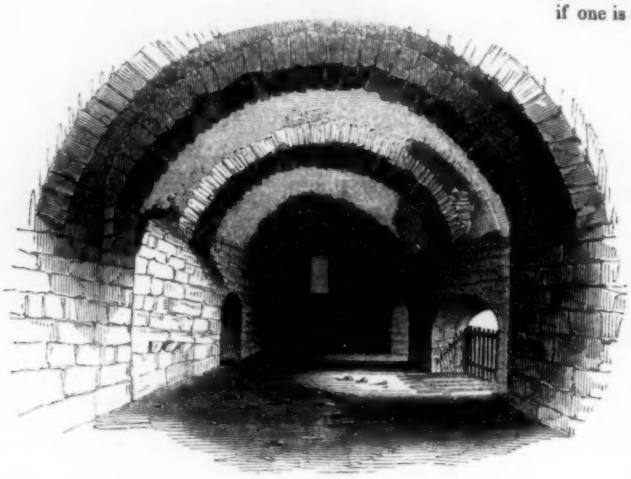
RADCLIFFE CHURCH.

This is a view of part of the roof, which is sustained by carved squares of oak, with tracery at the intersections.

[Roof of Radcliffe Church.]

RADCLIFFE TOWER.

A view of the interior. Radcliffe is about a mile west of the road from Manchester to Bury, and about seven miles from the former. "The glory of this place are the ruins of the famous tower, the hall of which was built in the reign of Henry IV. The hall was of wood, and is described so late as the year 1818, by Dr. Whitaker, as retaining its essential features. 'The old hall'



[Radcliffe Tower.]

(he says), 'adjoining the tower, is 42 feet 2 inches in length; in one part 20 feet, and in another 28 feet in width. The two massive principals which support the roof are the most curious specimens of carved work we have ever seen. The broadest piece of timber is 2 feet 7 inches by 10 inches. A wall plate on the outside of one beam, from end to end measured 2 feet by 10 inches. The walls are finished at the squares with a moulded cornice of oak. The pillar at the right has neither capital nor moulding, and appears to have been inserted at a later period, when the hall underwent repair."

We regret that the want of space will not at present permit of any extracts from the work to show its value as a natural history of the country, and the merit of the minute and detailed descriptions which it contains of the arts and manufactures of Lancashire. We understand that the publication of the parts relating to Cornwall are in progress at the same time with those of Lancashire. The work, in every respect, is certainly the best topography which has appeared since the days of Britton and Brayley. Its illustrations are in the first style of steel and wood engravings, and the talents and acquirements of the editor, Mr. Redding, afford a sufficient guarantee that the future numbers will not possess less of interest and instruction than those which are before us.

A Treatise on Engineering Field Work, comprising the Practice of Surveying, Levelling, Laying out Works, and other Field Operations connected with Engineering. By Peter Bruff, C.E. London: Simpkin, Marshall, and Co., 1842.

THE practice of levelling is distinguished by this peculiarity from the other operations of the engineer, that amongst the innumerable persons who profess to understand it, and who are excellent levellers if one is disposed to take their own word for it, scarcely one in a hundred is to be trusted with safety to take levels under any circumstances where even common accuracy is required. The mere principles on which levelling operations depend are probably not more intricate nor more difficult of comprehension than those of chain surveying, and yet, although the same person may be separately instructed in the theory and practice of each in the same time, most egregious and fatal would be that folly which should trust the tyro with the conduct of levelling operations, notwithstanding he might safely be sent into the field to apply in ordinary chain surveying the principles comprised in his course of instruction.

A youth may be taught by a few weeks' practice in the field book and in the office (for one is as necessary as the other,) the geometrical relations of lines, and the system of measuring and connecting them together in a proper manner so as to form the proper ground-work for laying down on paper the representation of an estate, a parish, or of a large district of country, and this constitutes the principal art in the measurement of land. As for the offsets, the method of taking them will scarcely require description, because, having once seen them taken by an experienced surveyor, guiding his own chain, as all surveyors ought

to do, he will have no difficulty in future in performing this part of the process himself. After this brief period of initiation by one who himself understands what he professes to teach—for this qualification on the part of the instructor is indispensable—a youth of moderate abilities may be sent to fill in the interior of a survey between the main construction lines; and some have been such apt scholars, and have profited so rapidly by a few judicious lessons, that they have been competent to go at once from this short course of instruction to the entire conduct of a survey, comprising the whole round of operations from the first laying out of the main lines to the plotting and computing their work in the office.

But in levelling the case is widely different. After the pupil has again and again been taught the principle on which its accuracy depends, namely, the production of a horizontal line through the axis of the telescope to the back station in one direction, and the forward station in the other; after all the adjustments have been carefully explained, and after they appear to be understood; after the method of entering both the direct and intermediate levels in the field-book have been again and again shown and illustrated by example, and the proper places and occasions for making bench marks have been pointed out; when the pupil has become quite confident that he thoroughly understands all these, and has gone forth in the full persuasion of his own capacity to act for himself without further guidance or instruction: after all this it is no uncommon thing to find, that he has become confused in the field by unexpected difficulties and perplexities, the result of which has been a section teeming with errors and absurdity. We have heard of such things as a novice in levelling puzzling his brains to such an extraordinary degree with allowances for curvature and refraction, as to have made an error of about 25 feet between the extreme points of a short line of 30 miles. We have heard also on good authority of an actual case in which a bench mark was fixed on a stone, which it appears was not a very solid fixture on the surface of the earth, and on which some rustic philosopher took it into his head to try the effects of removing it a few feet further down the hill than where it was when the bench mark was made the night before. In the morning the unsuspicious youth, who was levelling, quite innocent of any proper observations to fix the spot where his bench mark had been made, started away from the new position to which his mark had been transported, and very industriously carried on an error of 14 or 15 feet through the whole series of his future levels. Instances of this kind are probably by no means rare; but it cannot be expected that many should be made public, because the heroes to whom they occur have discretion enough to keep the circumstances as much to themselves as they can, seeing they are not calculated to reflect upon them any thing in the shape of either glory or credit. There are also many sources of intricacy and confusion which will often occur to perplex the student in taking a line of levels for the working sections of railways and canals, where cross sections have to be shown, and where many intermediate levels have to be inserted in the level book without altering the position of the instrument.

These circumstances afford some apology for even an extensive work on levelling, supposing it to be the production of a thoroughly practical man, because, next in value to the oral instructions and personal communications of such a man, may be ranked the written instructions which he lays before the world in a treatise on the subject. Mr. Bruff is well known to the world as one of this class: whatever may be said of his book, he certainly possesses the *primâ facie* qualification for producing a useful work on levelling, seeing that he is himself one of the most able and experienced practitioners which the country can boast of. This is no mean praise, considering how few there are who really possess all the necessary qualifications for a good leveller; since the skill, the patience, the steadiness, the industry, and coolness of judgment, which are all essential to form a leveller worthy of confidence, are confined to very few indeed of that great host of pretenders who, in these days of conceit and arrogance, are ready to undertake any thing which is placed before them.

Engineers well know the value of experienced and trust-worthy levellers; and the greatest engineers in no particulars of their professional practice exhibit more judgment than in the selection of field engineers, to act under them in exploring and laying out great lines of communication, whether for roads, for railways, or canals.

In the two first chapters, Mr. Bruff takes a review of the theory of levelling, and of the various instruments which have been used for ascertaining levels. As might be expected, he gives a decided preference to the spirit-level and staff, compared with any of the water-levels, the reflecting level, the mountain barometer, and Dr. Wollaston's method by means of the temperature of boiling water. These last are dismissed in rather a summary manner, as "methods which can never be employed with any degree of certainty." Not exactly agreeing with Mr. Bruff in this conclusion, we shall reserve any remarks on this subject for a future occasion, when we propose to enter systematically on the subject of levelling with the mountain barometer.

In the third chapter, Mr. Bruff gives the form of field-book which he recommends. To this, in our opinion, there are several objections, of which our readers will judge for themselves, from the following specimens (*see below*) placed before them.

It may be said that there is no material difference between these two methods of keeping the book; but we contend that the one is much more simple, and less liable to error than the other; and the direct system of three distinct checks which it presents, and the process of deriving the reduced levels, by exhibiting the subtraction or addition of the falls and rises, would, in our opinion, be more intelligible to a student than the form given by Mr. Bruff. Our own form is not original, but has been used by some of the most experienced practical engineers in the kingdom; and all attempts to alter it which we have seen, have always impaired its

FIELD BOOK RECOMMENDED BY MR. BRUFF.

Elevation.	Back sight.	Fore sight.	Depression.	Total rise.	Distance.	Remarks.
				100·	0·00	B. M. above assumed datum, on root of tree, level with ground at commencement.
7·86	9·20	1·34		107·86	2·00	
10·89	11·32	·43		118·75	3·70	
9·64	11·24	1·60		128·39	6·00	
	7·80	10·68	2·88	125·51	10·00	
	2·76	7·16	4·40	121·11	18·00	
7·27	9·22	1·95		128·38	28·00	
35·66	51·54	23·16	7·28			First reduced level to be deducted from last.
7·28	23·16			100·00		
28·38	28·38			28·38		

FIELD BOOK RECOMMENDED BY THE EDITOR.

Distance.	Back sight.	Fore sight.	Rise.	Fall.	Reduced Levels.	Remarks.
0·00	100·00	..	100·00	..	100·00 7·86	B. M. above assumed datum on root of tree, level with ground at commencement.
2·00	9·20	1.34	7·86		107·86 10·89	
3·70	11·32	·43	10·89		118·75 9·64	
6·00	11·24	1·60	9·64		128·39 2·88	
10·00	7·80	10·68		2·88	125·51 4·40	
18·00	2·76	7·16		4·40	121·11 7·27	
28·00	9·22	1·95	7·27		128·38	Rise.
	151·54 23·16	23·16	135·66 7·28	7·28		
	28·38	Rise	28·38	Rise		

simplicity, and therefore detracted from its merit, without substituting any corresponding advantage.

At pages 61 and 62 we find some rather heterodox notions, concerning which we feel bound to enter our most decided protest. The following extract contains them:—"When a long line of levels is to be taken by a system of short sights, it will be absolutely necessary to introduce a third place of decimals to insure accuracy, in consequence of the frequent *bisection* of the hundredth divisions making it doubtful, with the observer, whether to give or take the ·005; if the former in the one case, he should take it on the next recurrence to balance the error. If he should neglect to do so, an error is involved; if he should take it on the wrong side, it is doubled, and becomes a sensible quantity. The more preferable method is, as we have suggested, to preserve the same graduations, but subdivide the foot into thousandths by *estimation*, which, so far as $\frac{5}{1000}$ths or $\frac{25}{1000}$ths are concerned, can be done with considerable accuracy! As a general rule, we should, however, say, give the ·005 on the longest sight, take it on the shortest; curvature will explain the reason why. On bisecting the $\frac{1}{10}$th of a foot with the *last* fore sight, desire the staff-holder to strike the staff down smartly, until the bisection is exactly *at* the $\frac{1}{100}$th. When the *back* sight is similarly circumstanced, the desired bisection may be made by a slight pressure on the level legs." We are no advocates for any such refinements as that of dividing the 100th of a foot in levelling, even by estimation; nor do we think this can be done, without introducing much greater liability to error than in the common practice. But let this pass; let those adopt it who choose; let them divide the foot into 10,000 parts if they please—the trouble of the additional calculation will be their own, and not ours; but whatever various practitioners may do in this respect, we would advise all those who are disposed to pay the least atom of respect to our individual opinion, by all means to have nothing to do either with *striking down the staff smartly*, or with *slight pressure on the level legs*. The former might break or injure the staff; and the uneducated staff holder instructed to do things of this kind, could scarcely help fancying that he had a piece of cast iron or a bludgeon in his hand, in place of a delicate instrument, to be handled with care and nicety. But the slight pressure on the level legs is far the worst of the two. What!—Mr. Bruff, a practical leveller of great experience, recommending, after the level is set, and the bubble adjusted with the greatest care, that the adjustment should be deranged by pressure on the legs during the time of making the observation. This will never do: the most watchful care which the leveller can exert, is often not sufficient to preserve the instrument in a perfectly horizontal position; and this being the case, and being at the same time so necessary that nothing can go right without it, we cannot imagine anything more calculated to mislead the student, and to render the practice of levelling imperfect, than an instruction so completely at variance with the principles of care and accuracy, which should guide the engineer in all levelling operations. We therefore recommend, and beg of the young engineer, whatever practice he may adopt with reference to the subdivisions of the foot, never to think of adopting so unscientific an expedient for obtaining either a higher or lower decimal in reading the staff, as that of pressing at all upon the legs of the level. Notwithstanding, however, this piece of instruction, which we consider ourselves bound to point out as a specimen of incautious recommendation on the part of Mr. Bruff, we have no hesitation in recommending the book, upon the whole, as a work of much practical value and originality, and one calculated to diffuse a more accurate acquaintance with the practice of levelling, than any we have hitherto seen on the subject.

Report to the Right Honourable the Lord Mayor, Aldermen, and Commons of the City of London, in Common Council assembled, on the Nuisance occasioned by Smoke from Manufactories and Steam Vessels.

An Account of the Patent and other methods of preventing or consuming Smoke. By William West, Professional Chemist, Leeds. London. Simpkin and Marshall, 1842.

A Practical Essay on Steam Engine Chimneys and Furnaces; to which is added a Supplement, containing a Critical and Impartial Account of New Inventions and Improvements in the Art of producing Steam without Smoke, or Danger from Explosion. By R. Armstrong. London. John Weale, 1842.

THE intolerable nuisance arising from the smoke of large towns, and particularly of those where extensive manufactures are carried on, and where many steam engines are employed, is at this time engaging the attention of a vast number of persons who have proposed plans for consuming or preventing smoke, and of the spirited corporations of London and Leeds, who are greatly desirous of introducing some expedients for entirely removing, or at least modifying, an evil so generally complained of. The Common Council of London having referred the subject to a committee, received in October last a report from that committee, consisting of a classification of various projects which had been submitted to them by upwards of forty-one parties, many of whom had taken out patents for improvements in furnaces, with a view to prevent or to consume their smoke. From this classification, we derive that the following

five distinct methods for effecting this object have been brought before the notice of the committee.

1. By the introduction of fresh or undecomposed air into the furnaces.

2. By coking or charring the coal in furnaces, such furnaces forming part of the ordinary furnace of steam boilers, coppers, &c.

3. By the introduction of a jet of steam, in conjunction with a jet of air, into the furnace of steam boilers.

4. By the use of anthracite Welsh coal (either *Langannock* or *Merthyr*), or coke.

5. By compressed fuel.

The most important communications relating to the means of abating the evils complained of, by these several methods, are given by the committee in a condensed form, and the result of the report was, not a recommendation in favour of any particular plan, but a general resolution by the Court of Common Council, "That petitions be presented to both houses of Parliament, complaining of the said nuisance and annoyance, and praying that a law may be passed to prevent a continuance of the same."

The pamphlet of Mr. West is a highly valuable production; he describes in a brief yet very distinct and intelligible manner most of the methods brought before the Committee of the Common Council of London, together with some others which do not appear to have been brought before the notice of that body. Mr. West became possessed of the particulars of these several plans from his own extensive inquiries, and from the information given by their respective advocates before a public meeting at Leeds, on the 12th of January, in the present year. The introduction by Mr. West is ably and impartially written; indeed, his observations throughout derive great value from the perfect impartiality by which they are dictated. He observes that, although it be an undoubted chemical fact that we cannot in one sense destroy smoke, as there must be equivalent gases produced in the place of smoke in its solid form, yet he conceives the effect of these gases when diffused through the atmosphere, and forming a very small part of its whole bulk, to be far less injurious than the solid carbon, which is the form taken by unconsumed smoke when it falls again to the earth. "Whether mechanical or chemical impurity, actually inhaled, be the worst," says Mr. West, "it is certain that the gas formed during combustion is rapidly diffused into the general atmosphere, and for the most part ascends; while the finely divided solid carbon, which is the result of imperfect combustion in a furnace emitting black smoke, must sooner or later descend. I cannot therefore admit arguments drawn from the noxious effects of an atmosphere, of which carbonic acid might form the principal ingredient, when applied to situations where it exists only in the ratio of a few parts in each thousand. Another complaint respecting smoke is, the injury to vegetation. The influence of the atmosphere of London is felt for ten miles round, and all who live in the neighbourhood of a smoky manufactory are aware, that the more delicate plants grow with difficulty in such situations, or perish entirely. I have traced the effects of a single factory chimney, by the grass in the direction of the prevailing or westerly wind being destroyed, and nothing remaining but rank weeds of a few species capable of resisting the smoke. Such effects I believe to depend in great measure on the soot, or carbon, deposited mechanically, and not on carbonic acid, which is beneficial to plants rather than otherwise." In these very sensible and just remarks we perfectly coincide, and it is difficult to conceive how any person with the slightest knowledge of chemistry can for a moment contend that an atmosphere containing a small proportion of the invisible gases into which carbon is decomposed by combustion, can be equally injurious with one which is loaded with palpable pieces of soot in a condition to be inhaled in a solid state, charging the lungs, the nostrils, the ears, the eyes, and every pore of the human body with impurities highly injurious to health, and offensive to comfort and cleanliness.

The chemical conditions of combustion are thus stated by Mr. West: "The worst portion of smoke is the superfluous carbon, which is left unburnt when either sufficient atmospheric air is not present, or the temperature is not sufficiently high for perfect combustion of the varieties of carburetted hydrogen, and the vapour of coal tar, which are disengaged from heated coal. Under either of these circumstances, the hydrogen inflames, while the carbon is left to be carried forward by the draught of the chimney, poured out at its mouth, and ultimately to fall to the ground, and form the nuisance so loudly and so justly complained of. It is further necessary that the due proportion of atmospheric air should be intimately mixed with the combustible gases before or during exposure to the requisite temperature, otherwise, however much may be introduced, it cannot be said to be present availably for the intended purpose. In ordinary furnaces, at the period when smoke is most abundant, that is, soon after putting on coals, both of these conditions are wanting—too little air is present, and the temperature is too low at the surface of the fresh fuel for perfect combustion. The principle, therefore, to which every plan for preventing or consuming smoke may be referred, is the admission of atmospheric air at such part of the furnace as is sufficiently hot for this combustion to take place."

Neither Mr. West, nor the Leeds meeting, nor the Common Council of London, having undertaken to recommend any particular plan, and as the proceedings which have taken place relative to the subject, both in London and Leeds, have been extensively circulated, together with the explanations by the different patentees and others of their separate inventions, we forbear at this time laying before our readers the particulars of any of these, but shall probably revert to the subject when further experience shall have determined in favour of one or other of the plans already mentioned. It is only fair to observe, however, that several of these have been in operation for some years; and in particular, the patentees of the methods for introducing fresh air into the furnaces, and of those for causing the smoke from the fresh coals to pass over the bright fire of another part of the furnace, have produced numerous and highly respectable testimonials from scientific authorities, and from parties on whose premises their methods have been used.

Mr. Armstrong's Essay is the first part of a work which is to appear in numbers, and which will probably extend to several volumes. It will scarcely be fair to judge of the whole from that which appears in so small a part, but at the same time we may remark on several points which appear calculated very greatly to detract from the merit of Mr. Armstrong's exertions to render better understood the subject of chimneys and furnaces, and the means of producing steam without smoke. In the first place, we are treated, in the opening of the subject, with about ten pages of extracts from Encyclopædias and other works, to show the difficult nature of the subject; an assertion for the truth of which all those who are not already aware of it would, we are sure, be quite content to take the author's word. In consequence of the great space thus occupied

by the opinion of others, we are treated with a small modicum of information from Mr. Armstrong himself, as the whole of the Part, without the Supplement, consists of only sixteen pages, ten of which are disposed of as we have stated. The other important objection we have to Mr. Armstrong's method of dealing with his subject is this, that the Supplement, far from being what he calls it, an impartial account of new inventions for producing steam without smoke, is on the other hand not only grossly prejudiced, but extremely personal and offensive to those who are unfortunate enough to hold different opinions from those of Mr. Armstrong himself. The only part of the subject which he appears to have treated in any thing like a practical or useful form is that relating to the dynamic effect of an engine, comprising, first, the estimate of its horse power, in direct proportion to the cubic quantity of water which the boiler is capable of evaporating in a given time; and secondly, the quantity of boiler surface required to be exposed to the fire in order to produce this rate of evaporation. Mr. Armstrong here entirely demolishes, at least as far as his own assertion is capable of doing, the theoretical estimate of boiler power, and boldly states that "the evaporation of a cubic foot of water per hour, which includes an allowance for waste, is generally, and very properly, assumed by steam engineers as the measure of a boiler horse-power, notwithstanding the repeated declarations of scientific men and theoretical engineers to the contrary." On the quantity of surface required to be exposed to the fire, Mr. Armstrong remarks that this, "as well as the area of the fire-grate, and the quantity of coal required, are also matters of the most simple and direct experiment, and have long since been ascertained in that way." Now, these are useful practical statements, and we shall look with considerable interest to the future parts of the work for facts and experiments confirming their accuracy. They embrace precisely those points in the practical working of engines which are most necessary to be correctly determined in the case of all calculations and estimates of their power, and hence their great importance to practical men. At the same time, in proportion to the degree in which experiment is here said to contradict theory, it becomes necessary that the experiments should be fairly and judiciously made, and that they be of sufficient extent to afford a law for detecting those anomalies which a few isolated experiments on any subject are almost sure to exhibit. The supplement consists of a laboured and systematic attack upon the project of Mr. C. W. Williams, and we particularly object to the terms of offensive personal abuse in which the writer here indulges. We see no reason, because Mr. Williams is a barrister, a gentleman, and a man of scientific attainments, that he should therefore be incapable of applying the faculties of his mind to the object of consuming or preventing smoke; and we are therefore very far from agreeing with Mr. Armstrong in the propriety of the numerous sallies in which he indulges at the expense of Mr. Williams. Take the following as a specimen: "Philosophers have yet to learn from the 'ignorant stoker,' that if sufficient air passes through the fire-grate, it requires none to go through Counsellor Williams's Patent 'Riddle' in order to burn smoke." And again: "The cold air Williams is, on the contrary, a hot-headed *ci-devant* Irish barrister, not a manufacturing, but a philosophical chemist, of the genus paradoxical, &c." It will be known to most of our readers that Mr. Williams is the patentee of the Argand furnace, in which the air is introduced by a separate channel, and not through the fire-bars and fuel. The furnace is provided with plates or tubes, which are perforated by numerous small openings, so as to separate the combustible gases arising from the fuel into very thin streams or filaments, and each being mixed with its due proportion of oxygen from the fresh air supplied, its combustion is effectually ensured without, as the inventor contends, producing smoke at all, the process being that of absolute prevention, instead of merely burning the smoke after it has been formed. In carrying on the war against Mr. Williams, the author of this Essay drags into the Supplement a very lame controversy, as far as he himself is concerned, which appeared last year in the columns of the Liverpool Mercury. Mr. Armstrong there proposes what he calls, "Jeffries Principle of preventing the nuisance of Smoke by the application of a shower of water;" and, however divided may be the general opinion on the subject of Mr. C. W. Williams's projects, there can be only one on Mr. Jeffries' principle, namely, that it is about the most stupid and ridiculous which has ever been brought forward for the prevention of smoke. The letter was answered by Mr. Dircks of Manchester, agent for the furnaces patented by Mr. Williams, and we think any unprejudiced person would admit that Mr. Dircks has most of the reason and common-sense of the case on his side. Mr. Armstrong's reply did not appear for twelve months afterwards, which delay, as he intimates—we suppose out of compliment to the editor—took place because he did not pay for the insertion of his letter; and, notwithstanding the long time which Mr. Armstrong—the ill-used and impartial critic of these new inventions—was thus able to devote to the defence of Mr. Jeffries' principle, and the demolition of the projects of Mr. C. Williams, we really do not perceive that he has any just cause for triumph by reason of any additional light he has thrown upon the subject, or of any success which has attended his efforts to overwhelm Mr. Williams and his projects with ridicule. In the remainder of the Supplement the war is still carried on against Mr. Williams in the shape of several reports and letters which Mr. Armstrong has been called on to make concerning boilers to which Mr. Williams' patent had been applied, and in which Mr. A. shows, very much to his own satisfaction and delight, the danger from explosion and other bad consequences of admitting cold air to the boiler bottom, and insists very strongly upon the necessity for discarding Mr. Williams and his project. These observations would be of more value and importance, were it not for a trifling fact which comes out in the correspondence between the parties, namely, that Mr. C. W. Williams appears to deny that the boiler which gave rise to them was fitted up on his principle at all, and very coolly intimates that some trick must have been played upon poor Mr. Armstrong, who, considering all the circumstances, and particularly his strict impartiality, does really seem to have been rather ill-used on all hands. He exults, however, in the prospect of triumphing over all his enemies in the future parts of his Essay, and hints in a very dark and mysterious manner that in the very next number he intends to give certain particulars connected with steam boiler explosions which are usually carefully excluded from the newspaper accounts of these occurrences.

We shall notice the future parts of Mr. Armstrong's work from time to time in connection with the general subject of his Essay.

Appendix D. to the New Edition of Tredgold on the Steam Engine, and on Steam Navigation. On the Archimedean Screw, or submarine Propeller. By Elijah Galloway, Civil Engineer. London: John Weale, 1842.

It will be unnecessary to say one word upon the vast importance to commerce, to engineering science, and to steam navigation in particular, of the interesting subject of this inquiry. Appearing at a time when prejudice still runs high against the substitution of the screw for the paddle-wheel, and when very little is practically known of the application of the former, the author has had much to contend with. This, however, only renders the credit more prominent of having succeeded in the very infancy of the screw propeller, in giving to the world a truly valuable treatise upon the most important points connected with it. This treatise is eminently worthy a far more advanced period in the history and the application of this new propeller, and Mr. Galloway investigates many points of great practical interest connected with the working effect and the construction of the screw, with an ability and ingenuity which mark in a strong light an intimate acquaintance with every detail of his interesting subject.

The screw of Archimedes has long been known as a machine for raising water, for which purpose it is extensively used in Holland and on the opposite coast of this country. Most of the large farm houses in the marshy districts of Norfolk and Suffolk are supplied with a pump of this description, which is there termed a "*dodman*," their provincial name for a snail, the form and action of the screw as a pump affording some real or fancied resemblance to this animal. Other applications of the screw as a machine distinct from its use as a borer, and its more universal use for holding and fastening in all kinds of timber and metal constructions, have occasionally been made, as, for instance, in some of the great breweries, where a long screw, working in an open canal partly filled with malt, causes, by its revolution, the malt to be set in motion, and to run along the curved blade of the screw, from the granaries to other parts of the building. These and similar examples are familiar and obvious adaptations of the screw as a moving power, but its substitution for the paddle-wheel in steam vessels, is one differing considerably from all its applications, except that of a pump for raising water. In both these cases its revolution gives motion to a fluid which, in the pump, is raised upwards, and by the propelling screw is carried forward, to communicate its motion to the floating body to which the screw is attached.

The principle of the screw propeller may be shortly stated in Mr. Galloway's words: "Screw propellers, however variously they may be modified, all derive their power of propelling by being placed on an axis which is parallel to the keel, and by having threads or blades extending from the axis, which form segments of a helix or spiral, so that, by causing the axis to revolve, the threads worm their way through the water much in the same way as a carpenter's screw inserts itself into a piece of wood."

Although Mr. Galloway shows that distant and isolated proposals to apply the screw as a propelling power in water have been made at various times, ever since the year 1727, yet the first practical employment of the screw in a steam vessel intended for actual navigation, was in the well-known vessel called the Archimedes. Her dimensions were as follows:—

Extreme length	125 feet.
Length between perpendiculars	106 „ 8 inches.
Extreme breadth	21 „ 10 „
Depth of hold	13 „
Draught of water aft	10 „
Do. do. forward	9 „
Burden	232 tons.
United power of engines	80 horses.

"The cylinders, instead of being placed transversely in the vessel, as in the case of vessels fitted with paddles, are placed fore and aft, or at a right angle to the ordinary position. They are of the kind called direct engines; that is to say, the motion is communicated from the engines to the cranks by the direct action of the connecting-rod, instead of being transmitted by levers. There is but one air-pump to both engines, which is worked by the intermediate shaft being cranked." The screw is fixed at the stern, on a shaft which extends from the engines to the stern of the vessel. This shaft is parallel to the keel, and about four feet above it. "The screw is 5 feet 9 inches diameter, and 8 feet pitch; it consists of two threads, which are opposite to each other, and of equal size and area, so that when it is viewed endways it appears like a complete disk." The flat plate, or blade of metal, forming what is here called the thread of the screw, makes one-half revolution round its axis, so that the length of the screw is just equal to half the pitch—namely, 4 feet.

Some interesting experiments are recorded upon the performance of the screw propeller, as compared with that of the paddle-wheel, in several vessels of about the same size, on which Mr. Galloway remarks:—

"The preceding facts, which are selected (to the exclusion of a mass of similar results) because the authorities from which they are derived render them indisputable, enable us to close this part of our investigation by the reasonable conclusion, that as far as the question can be decided by such trials as we have enumerated, there can be no doubt that the performance of the screw *has not proved to be inferior* to that of the paddle-wheel. Until two vessels of the same form and power (one fitted with the screw, and the other with the paddle-wheels) shall have made several voyages, so as to test their comparative advantages in various kinds of weather, this is as far as the most extensive trials of this kind could lead us." So desirable an experiment, we are happy to state, the Admiralty are in progress of making, having ordered the "Rattler," now building at Sheerness, to be fitted with engines by Messrs. Maudslay and Field, of 200-horse power, and with the screw. She will be of precisely the same power and build as the "Polyphemus," so that this highly interesting question will be thereby set at rest.

Mr. Galloway enters at some length into theoretical investigations of the power of the screw, its pitch, and the area which should be given to command a certain velocity. There are also some excellent practical observations on a method of casting the screws, which had been adopted at Messrs. Rennie's under the author's superintendence. The next is a useful section on the mode of communicating motion from the engine to the screw; and the work concludes with a descriptive notice of the various forms of propellers now before the public. Amongst these are Ericson's propeller; Mr. Rennie's spiral propeller, an elegant and ingenious modification, founded on the form taken by the tails of the swift-swimming fishes, when in motion; with those proposed by Messrs. Hunt, Blaxland, D. Napier, and Captain Carpenter. Unques-

tionably, in the present state of our knowledge respecting this new method of propulsion through water, the treatise before us is a valuable appendix to the great work on the steam-engine which it is intended to accompany.

Mr. Galloway states, in conclusion, that four vessels have already been fitted with screws under the patent of Mr. Smith, whose form is that before described in speaking of the Archimedes. The "Great Britain," now building at Bristol, is to be propelled with the screw driven by engines of 1000 horses' power. A vessel of 1500 tons is also just completed at Londonderry, which is to be propelled in the same way.

Wilme's Hand-book for Plain and Ornamental Mapping, and Engineering Drawing. London: J. Weale.

Part III. of this work is before us. It contains five plates, showing the various styles of tree suitable for the ornamental work of maps—the conventional terms used in mapping—the method of showing strata in section, as applicable to engineering drawing—a study of alphabets—and an example of the method of delineating mountains. This work might be made more useful, if Mr. Wilme would reject all but the best examples of the different styles of writing and embellishments which he represents. A style is not necessarily worthy of imitation by others, because it has been practised by one or two surveyors or engineers. On the contrary, it may often be in exceedingly bad taste, and not at all adapted for what it professes to exhibit. We should also wish to see the zincographic plates of the book executed in a better style than those in the part before us; and considering the price of the work, it seems reasonable that an improvement in this respect should be adopted in future.

The Hydraulic Railway; being a carefully digested but plain Statement of the Advantages to be derived, and Impediments removed, in establishing Hydraulic Propulsion on Railways. By J. G. Shuttleworth, (the Patentee.) London: J. Weale, 1842.

Ecce iterum Crispinus. Here is another of the herd of pigmy philosophers, who would find much fitter employment in minding "his thrums and his shop," than in the vain attempt to astonish and illuminate mankind. No animal but a reviewer would, we verily believe, undertake to work through a hundred and six pages of trash so intolerable—dull as the *tenthly* of a Dutch theologian, and as full of fallacy as of dulness. At all events, there are few of our readers we fear of sufficient virtue to penetrate far into this intellectual *del fuego*, and we therefore purpose to give them the benefit of such discoveries as we have been enabled to make in our pilgrimage through it.

In his preface, Mr. Shuttleworth expresses the very laudable desire of "avoiding to give others the trouble of pulling this pamphlet to pieces," and he therefore very considerately accomplishes the work of demolition himself, so effectually, too, that a catalogue of his quavers and ejaculations would probably be the severest thing a ruthless critic could perpetrate. Yet he assures us, that if he has fallen into follies and blunders, it is not intentionally done, as "he trusts nothing like an intentional error will be considered as apparent;" and as to unintentional errors, they, it would appear, are to be atoned for by the distinction of having been for twenty years "a soap-boiler by position." Having duly explained these things, Mr. Shuttleworth introduces us to his scheme, very much after the fashion of the pedagogue in Moliere's comedy, who began his oration with the beginning of the world, for he first descants upon the objects of science in general, of mechanical science in particular, on railways in India, couriers and horses, Napoleon, the wonders of steam transit, Louis XIV. and Versailles, besides inquiring into the general economy of railway intercommunication, past, present, and prospective, and a thousand other things which have no more to do with railways of any kind than with the mountains of the moon, before he condescends to say a word upon the subject of hydraulic propulsion, or drop the slightest intimation as to the nature of the scheme he desires to bring forward. Although Mr. Shuttleworth's own time may be valueless, such he should have remembered may not be the case with all who are interested in railway inquiries; and had his scheme been good for anything, we should have seriously recommended him to compress his hundred and six pages into three, which might quite as well be done, without the omission of anything in the least important.

But Mr. Shuttleworth's scheme is visionary and useless. It consists in laying a pipe along the whole length of a railway, in which a piston is to travel, and give motion to the carriages. This piston is to be impelled by water-pressure, procured either from a natural head, or a reservoir, into which it is forced by steam power; but the piston is not to be impelled continuously, but, after having been forced on about a hundred feet, it is to pass a valve which prevents the water from following it, and advance about another hundred feet through an empty pipe by the momentum of the train, at the end of which distance it is to enter another pipe, to which the water is let on, and be impelled through another hundred feet by the water pressure as before. Thus a hundred feet of water pipe is to alternate with a hundred feet of empty, or, as Mr. Shuttleworth calls it, of skeleton pipe along the whole line, and at every junction of the full and empty pipe there is a valve which the piston has to pass in its progress. Underneath the main or impelling pipe, a feed or supplementary pipe has to be led along the whole length of the line, for letting on and off the water to the lengths of impelling pipe, at the proper intervals; and, on the upper side of the impelling pipe, a cleft extends through its whole length, for enabling the neck which connects the piston with the carriage to pass forward. This cleft is filled and made tight with a rope formed of iron wire, Indian rubber, and pieces of whalebone; and there is a little wheel running before the piston to press the rope down into the pipe so as to let the neck pass on, and another behind the piston for pressing it up so as to prevent the water from running out after the piston is gone by.

Such is an outline of Mr. Shuttleworth's scheme, and a scheme so absurd we really feel to be beneath our criticism. It is strange that it should never have occurred to Mr. Shuttleworth that, if he were only to put at each of his stations a drum for winding up his wire and Indian rubber rope, his whole complication of valves, and pistons, and water-pipes, would be rendered unnecessary. It is wonderful what trouble people will give themselves to find an expensive substitute for a thing abundant, cheap, and simple—a rope.

NEW SCALING INSTRUMENTS.

TO THE EDITOR.

SIR,

IN the number of your Journal for July, Mr. Mason complains that something like an attempt has been made to divide with him and the Messrs. Troughton and Simms, the credit of having invented a method for computing the contents of maps.

Mr. Mason states that he invented the principle in May, 1839, and applied it in computing Tithe Commutation Maps the August following, and that the instrument of Messrs. Troughton and Simms was not known to the Tithe Commissioners for some weeks afterwards, and he further states that from this it clearly follows that the invention is his, and that to him alone is all the credit due.

I can say nothing as to the relative merit of the parties, but, admitting that Mr. Mason has a prior claim to the Messrs. Troughton and Simms, it does *not* follow that he is the first inventor, and this for one very good reason: I have computed maps on the same principle of parallel lines nearly two months before Mr. Mason's invention; the method was communicated to me by a surveyor, two of whose assistants had used it at least six months previously. I cannot with certainty ascertain the source from which this invention has come to me, but although I am far from calling into question the justice of Mr. Mason's claim of invention, I conceive he is not the greatest inventor, because he is not the first.

J. M.

Norwich, July 27, 1842.

ON THE LEAD COUNTRY OF NORTHUMBERLAND, DURHAM, AND CUMBERLAND.

DR. MITCHELL'S REPORT. (*Continued from page* 207.)

A CONSIDERABLE quantity of ore is obtained by a method called "hushing." Where a great ravine has been formed by the streams on the side of a hill, and water comes down over the stones and clay and earth, and ore has been discovered, then it is known that it is a good place for hushing. A dam is made at the upper part, and a channel is made for the water, some of the larger stones being laid to one side; then, when the dam is let out, the flood of water rushing down with all its fury, tears up the earth and stones with immense devastation, and lays bare new surfaces to view. Then the man who has undertaken the work, and the boys who assist him, go into the ravine and pick up all the ore laid open by the water.

At Silver Gill, close to Roughton Gill, five miles beyond Hesket, Newmarket, two Yorkshiremen had just taken the ground in August last, and were about to begin hushing. It was an old mine, and they were to hush the rubbish. But hushing is chiefly carried on where the ravines disclose new veins, and the water running along in its fury tears up the stones containing the metal. Of course rainy weather, which will enable quickly to collect a dam of water, is favourable to hushing. The work is about as agreeable as washing the ore, and wages are much the same, according to the ages of the boys.

There are many hushing places seen on the road side from Weardale to Nenthead, in Alston Moor.

OF WASHING THE LEAD ORE.

The object of washing the lead ore after it has been brought from the mine is to separate the lead ore from the limestone, sandstone, barytes, or other matter with which it is united or mixed up. Some men, and very many boys under thirteen, and young persons under eighteen, are employed.

The operations for carrying into effect this purpose depend on a supply of water. The work is necessarily suspended by the frost, and when the frost has permanently set in it is discontinued altogether till the spring. The work is also partially liable to be interrupted in dry weather in places where water is not abundant. It is chiefly performed by water flowing off the surface; and seldom is an opportunity of doing it at streams bursting out from the interior of the mountains, and accordingly there is the smallest supply of water in the beginning of June, when the water in drawwells and issuing from the interior of the ground is most abundant. On the other hand, it becomes more abundant in the end of July and following months, when the springs from the bosom of the earth are most deficient. The practical effect of this state of things is, that at one time the boys and young persons work fewer hours than usual, and at the other time they work more hours to make up for it.

It is a great advantage to a mine when it is situate near a river, or a large and copious burn of never-failing water; but frequently it is necessary to take advantage of the smallest streamlets; and artificial means are taken to collect water by means of dams, the outlets of which can be stopped up at night, or at times when the people are not employed. In East Allendale Mr. Beaumont has a dam which is said to cover seven acres of land: but in general the dams are not nearly so large.

In former days the washing of the ore was a very simple and rude operation: it was placed on a buddle, or space of ground, made a few inches lower down than the other ground, and in extent not much larger than the door of a house, and with a gentle declivity, so that water coming at one end might slowly flow over the stony bottom to the other. The water carried off the loose dirt, or clay, or pulverized stone. The solid pieces of ore were broken by a rude instrument called a Bucker, which is not yet entirely out of use. This instrument consists of a flat piece of iron about the size of a man's open hand; at the back of it is a broad ring, through which is thrust a piece of wood for a handle. The boy takes this instrument in his hand, and, striking the ore with it, breaks it into pieces, by which means the water is able to carry off the earthy matter, and leave the metal behind. The large pieces of lead thus separated from extraneous matter, are carried away in a state fit for the smelting mill. Other pieces are put on a sieve, as will hereafter be described.

In small concerns in the distant fells, which will not afford the expense of machinery, and where also there may be but a small supply of water, this mode is still in use. A few persons may also be seen employed in this way as auxiliary to washing establishments, working at buddles along the side of a gill, taking advantage of the little streams of water which flow down after a heavy fall of rain. It is obvious that in this mode of washing many small particles of lead must be carried away; and although this is in part obviated by the water falling into pits, and these depositing and

leaving much of the lead, still a portion is carried off and for ever lost.

About forty years ago crushing mills were introduced, and other improvements have since been made, by which the lead is separated from earthy matter at much less expense, and also a greater proportion of lead is extracted. The consequence is, that the good mines are rendered more profitable, and some poor mines, which on the old system would not have yielded a profit, can now be worked to advantage.

As preliminary to the operations of the crushing-mill, the larger pieces of ore are picked out by boys from the heaps. Sometimes large pieces of pure galena without any earthy matter, and sometimes large pieces which may be broken off with the hammer from the stone, occur in the same lump. These are carried at once to bingstead, as requiring no washing to be done to them.

The ore may also be placed upon bars of iron, called a grating, and a stream of water flows upon it. The smaller pieces are carried by the water through the bars, and down an inclined plane to a place below. Upon the grating remain the pieces too large to get through. Some of these are dead pieces of stone, containing no metal: these are picked off by boys, and thrown aside. Pieces of unmixed galena are also picked off. The remaining matter of ore and stone goes to the crushing-mill.

Much depends on the nature of the stratum from which the ore is obtained. Some which is found in strata of barytes, comes out in dust or small fragments, and may be carried by the waggons, so as at once to be let down, by opening the hole in the bottom, into the hopper, which is over the mill.

Where the pieces are many of them of a larger size, they must previously be broken and grated, as has already been stated.

The crushing-mills require a plentiful supply of water to drive the great water-wheel, as well as to perform the other subordinate operations: but these mills are very far from being all upon the same scale. The great water-wheel is in the middle; and on one side—generally on the left-hand side, to a person looking forward in the direction in which the water runs—are the wheels which break the bouse-ore, or the ore in its rough state; and on the other side are the chat-mills, which are for breaking and bruising the ore which has been crushed or ground into smaller pieces.

The bouse-ore is let out from the hopper by a machine called a shoe, or else a boy or young person gradually lets it out. In either case, it falls between two rollers, which are deeply fluted, and revolve and work into each other. A body of water falls down between the rollers at the same time. In passing between these fluted rollers, the ore is crushed into smaller pieces; and these pieces, together with the smaller ore which accompanied them on coming from between these two rollers, fall down two inclined planes—one inclined plane to the right, and the other to the left—two rollers on the right, and two rollers on the left, both of these pairs of rollers being of the same sort. These rollers are smooth, and between them the ore passes, along with a body of water, and is further ground, and falls into pits below. A certain portion of the ore still escapes, of a large size; because, if a large piece of ore comes between the rollers, they are forced to recede sufficiently far to let this stone pass through, and the other pieces of stone as well take the opportunity, and slip through unbroken.

These three pairs of rollers are not fixed together to the same position. In case of a large piece of stone coming between them, they may recede, and let it through; and but for this contrivance, the mill might be damaged or choked up. The rollers, however, are immediately brought back to their right position by means of levers, at the ends of which are attached large weights, usually stones, for effecting this purpose; and the depression of the lever brings up the roller attached to it, to its proper position.

Any of the pairs of rollers, in case of a great stone coming between them, may move asunder from each other, to let the stone pass, and are brought close together again by the action of weights.

From the pits below the crushing-mill, the broken ore is drawn up to the chat-mill, on the right-hand side, by means of iron buckets on an endless chain, much in the same way as we see, on a larger scale, the ballast drawn up into the barges, from the bottom of the river Thames. Every bucket, on arriving at the top, discharges its load upon a grating, by the bars of which the larger pieces are retained, and are passed again through the crushing-mill, or sent into the stamping-mill. The smaller pieces are made to pass the three pair of chat-rollers, which are exactly on the same plan with the crushing-rollers, only being on a smaller scale, and adapted for ore of a smaller size.

As the crushed ore comes from the chat-mill, a boy stirs it, and much is disentangled, and much of the small lead, with dirt adhering to it, is carried by the stream of water to pits lower down.

The stamping-mill is used for breaking the hard, refractory pieces of ore, which resist the rollers of the crushing-mill and chat-mill. In some places the stampers are separate and distinct from the crushing-mill, and in other places the same water-wheel turns the rollers of the crushing-mill and raises the stampers.

The broken ore is carried down an inclined plane by a stream of water.

(*To be continued.*)

ALMS HOUSES RECENTLY ERECTED AT BALL'S POND, ISLINGTON, FOR THE WORSHIPFUL COMPANY OF DYERS.

S. S. TEULON, ARCHITECT.

(*With a Plate.*)

THE instructions of the Building Committee required that as little separation as possible should be made of the parties intended to occupy these houses, and one stair-case was therefore determined to be adopted for the use of every four persons. The general arrangement under these circumstances for the present number of persons, (viz. ten,) consists of two double houses, each to receive four persons, and one single house in the centre for the reception of two persons. The double houses have each a porch, opening into a spacious hall, with the staircase at the end, with two rooms on each side, and the same accommodation above, thereby providing two rooms for each person, with closets and other conveniences. In the rear is a washhouse for the use of the occupants on alternate days, and a separate coal shed for each person. The single house, forming the centre feature, has a corridor opening into an entrance passage, communicating with two rooms on the ground-floor; the staircase is constructed intermediately of the rooms, without preventing access from one to the other, and is lighted by an octangular lanthorn, which rises above the roof, and affords a sufficient ventilation as well as light. There are two rooms on the upper floor,

THE ALMS HOUSES ERECTED AT BALLS POND, ISLINGTON,

FOR THE

WORSHIPFUL COMPANY OF DYERS.

with a passage forming a communication between them. This house has also a wash-house and coal sheds in the rear the same as the other houses. The frontage of the whole building is 77 feet 8 inches, having a depth of 26 feet, exclusive of the out-buildings; the rooms are all 8 feet 6 inches high, and are fitted up suitably to their purposes. The exterior character, which is Tudor, is built with a light coloured brick, with stone dressings; the chimney shafts are worked in brick, except the intermediate shafts, which are of terra cotta, as well as some other details in the elevation. The front is enclosed with a perforated brick wall (a portion of which is shown in the foreground of the engraving), with ornamental gates framed in wood work, having the upper panels of cast-iron tracery; the gates are approached from King Henry's Walk by a bridgeway, with parapets in unison with the wall. The establishment is provided with water by means of a well which yields a good supply of spring water, and, besides this, a rain-water tank receives the water from the roofs. The total cost of the whole establishment, including 600 feet of enclosure wall, with the entrances, the well, rain-water tank, drainage, bridge, stoves, and the fittings, was £1560.

LITHOLOGY,

OR OBSERVATIONS ON STONE FOR BUILDING, BY C. H. SMITH.

(*From the Transactions of the Royal Institute of British Architects.*)

PART I. TREATING CHIEFLY OF THE SANDSTONES.

WHOEVER has travelled extensively in Great Britain for the purpose of examining architectural works of the present and past ages, cannot be otherwise than surprised at the remarkable difference in the condition and durability of the stone. Many beautiful buildings of recent date are in a worse state of external decay than some which have borne the vicissitudes of summer and winter during six or seven centuries. To discover the causes of such decay, and the means of avoiding the evil in future, may appear to be an investigation of some difficulty, especially if we consider the immense variety of stones used for building in this country, each composed of various elementary substances, and in very different proportional qualities; yet, although we may not arrive at a perfect knowledge of the facts, some advantages may be derived from the attempt, such as suggesting inquiries, and giving interest to an important and heretofore unexplored subject, or generalizing and arranging sound practical observations, so as to induce others to take it up. Thus, by a series of well-directed experiments, founded on extensive research amidst old buildings, certain conclusions may probably be inferred, which may ultimately be established on what approaches to scientific evidence. Whoever expects to find a stone that will stand from century to century, deriding alike the frigid rains and scorching solar rays without need of reparation, will, indeed, search for the "philosopher's stone." There is scarcely a substance which, after having been exposed to the atmosphere for a considerable time, does not exhibit proofs of "weathering;" it may even be observed on the most densely compacted siliceous rocks. The fullest extent of this inquiry can only be to elucidate relative duration, and comparative labour of appropriation to useful or ornamental purposes. By examining the various productions of nature, we find evident proofs of her industry in all ages: changes have been going on, from the remotest antiquity to the present time, on every substance that comes within our observation. All the actual combinations of matter have had a former existence in some other state. Nothing exists in nature but what is likely to change its condition and manner of being. No material is so durable as always to retain its present appearance, for the most solid and compact bodies have not such a degree of impenetrability, and so close a union of the parts which compose them, as to be exempted from ultimate dissolution. Even in the great globe which we inhabit, nothing is more evident to geologists than a perpetual series of alterations. There can be discovered no vestige of a beginning, no prospect of an end. In some bodies these changes are not so frequent and remarkable as in others, though equally certain at a more distant period. The venerable remains of Egyptian splendour, many of them executed in the hardest granite between three and four thousand years since, exhibit large portions of exfoliation and gradual decay, thereby following the primitive, immutable, and universal order of causes and effects, which the Creator has assigned to his productions, namely, that all objects possess the materials of which they are composed only for a limited time, during which some powerful agent effects their decomposition, and sets the elementary particles at liberty again to form other equally perfect combinations. Thus, by divine and unerring laws, order is restored amidst apparent confusion.

During the last ten or fifteen years, the various improvements in arts, sciences, and manufactures, have been carried to an extent unknown in any former period; and these changes have frequently given rise, either directly or indirectly, to ideas which have ultimately led to results of great public utility. With this sort of universal advancement the constructive department of architecture seems now to be somewhat following in the popular current. For a long period the most refined taste in elegant architecture was extensively practised throughout this country upon scientific principles, which, if ever equalled, have most assuredly never been surpassed; yet the quality of the stone employed seems rarely to have been considered further than for the facility with which it might be wrought by workmen. Relics of long-departed grandeur, either of the ecclesiastical or baronial order, abound in most parts of the kingdom; nearly all these beautiful works of our ancestors are constructed with stone from the immediate neighbourhood of such buildings, apparently without any regard to colour, strata, and durability; and hence we frequently find stones of very different tints indiscriminately placed together in the same elevation, some extremely perfect, others in a mouldering condition.

It is easy to conceive the difficulties that would arise in obtaining so large a quantity of so ponderous a substance as stone from the distance of only a few miles; and in situations remote from the sea or from navigable rivers, at a period when few good roads were available, and canals were neither known nor thought of, the transporting a supply of stone for an extensive edifice would necessarily be attended with vast labour, and, in many cases, would appear to be an insurmountable difficulty. In nearly all the old English buildings we rarely find a stone larger than might be conveniently moved or carried by two or three men, and there is good reason to believe that, notwithstanding the quarry might be but a few miles distant, probably over hills and dales, the most practicable mode of conveying the stone to the building was by pack horses, of either single or double burden. While these numerous

disadvantages existed, we need not be surprised to find materials of an inferior quality used for the sake of convenience in the construction of all kinds of edifices, and frequently even in those of a magnificent character. No doubt these circumstances originated sometimes from necessity, at other times through ignorance; but an attentive examination of various old buildings will soon convince us that economy was formerly, as it too often is now, the ruling power, far more so than a casual observer would imagine. Even at one of our principal seminaries of learning, there is a remarkable instance of ostentatious display executed in the most fragile stone that I have ever beheld.

Nearly all the colleges, halls, churches, and other public buildings at Oxford present elegant architectural designs, and, with few exceptions, they are now in the most ridiculous looking state of decomposition. Here we have an evident proof that those who had the direction of the works knew they were using a bad material, because, in many examples, the greater part of each structure is executed in Heddington stone, which is procured from quarries about a mile or two from the university, and may be worked with great facility; but wherever it has been used the result is deplorable in the extreme, every exposed surface appearing affected by what in medical language would be termed a cutaneous disease, peeling off and hanging like paper or rags. But the more exposed parts of the same building, such as have mouldings or cornices, are formed of a very superior stone from the Taynton quarries, distant about twelve miles land carriage, which increases very considerably the expense of such material: it is therefore rarely introduced. But notwithstanding the Taynton stone has been put in situations most likely to be affected by the weather, it almost invariably appears to be in an excellent state of preservation, and fit to be used again without fresh working the surface, in all cases where the buildings have been restored or rebuilt according to the original design. I am not prepared to say whether Caen stone was used in this country before the Norman invasion, but it appears to have been considerably, though far from generally, used for ornamental architecture in the south of England, from the Conquest to the time of Henry the Eighth. It does not seem to possess any advantages over various stones of the same character, the produce of our own country. Many qualities of stone are to be found in the same district, and frequently even in the same quarry. This remark is particularly applicable to the Caen stone; the proprietors sell the coarse-grained inferior kind, fit only for plain buildings, at probably half the price of such as is suitable for sculptural and ornamental purposes. All these varieties possess different degrees of durability. The central tower of Canterbury cathedral, St. George's chapel at Windsor, and Henry the Seventh's chapel at Westminster, were all built with Caen stone about the same time, between 1472 and 1517, yet the tower of Canterbury, notwithstanding its elevated and exposed situation, is at this time in a much better condition than the generality of structures of that date; and St. George's chapel is by no means so much dilapidated as that at Westminster before it was restored between 1808 and 1822. I am inclined to believe that the cause of so much difference in durability arises much more from the different qualities of the same description of stone than from any local circumstances; the north front of Westminster Hall, finished about 1400, situate in the immediate vicinity of Henry the Seventh's chapel, with an aspect equally unfavourable, was not, before its restoration eighteen years ago, so much dilapidated as the latter building, although erected one hundred years earlier. In London the demand for stone has at all times been considerable. During the period that the chief supplies for highly decorated buildings were imported from Normandy, various circumstances must have occurred to delay the arrival of cargoes. Political disputes between the two countries most probably occasioned the importation of Caen stone to be altogether prohibited. At such intervals, the rocks nearest to the metropolis would necessarily be made available; and accordingly, in almost all old buildings we find occasionally introduced large portions of stone from the vicinity of Ryegate and Godstone, known by the names of Ryegate stone, Gatton stone, Merstham stone, fire stone, and more commonly as hearth stone. This material must always have been expensive in London, on account of the distance to fetch it, being 20 miles land carriage. It may be very expeditiously worked, nevertheless it ought not to be used for external purposes, as I do not recollect an instance where it has been exposed to the atmosphere for 20 or 30 years without the surface having mouldered away in small flakes, so as ultimately to obliterate all architectural details.

(To be continued.)

ARTESIAN WELL AT GRENELLE.

We are favoured by an engineer from this country, at present residing in Paris, with the following particulars relating to this interesting project. The Artesian Well in the plane of Grenelle was commenced in 1834, under the superintendence of Monsieur Mulot. From that time till the present, the works have been continued with great perseverance and zeal. By December, 1836, the boring instrument had penetrated to a depth of 383 metres, passing through strata of alluvial earth, sand, and successive beds of flint and chalk. In June, 1840, the borer had reached 466 metres, and still continued to bring up chalk. In the month of February, 1841, however, a greenish sand had been drawn up, which gave rise to the supposition that the boring instrument was near the water. This fortunately proved to be the case, as on the 26th of the month the tube gave passage to a little water, which soon after bursting out with force, broke through the spring and wheel work which surrounded the tube to a depth of about 10 feet; and thus, after operations which had lasted more than seven years, the enterprise appeared to offer every prospect of being crowned with success.

The sand which was at first brought up by the water was greenish, and was succeeded by some of a yellow colour. The temperature of the water was 28° centigrade, which is equal to 83¼° Fahrenheit. The boring instruments broke several times during these arduous operations, which gave great inconvenience and trouble; they were subject more particularly to this in the month of May, when the bar united formed a length of 407 metres, or 1335 feet. At this time it broke, and its recovery caused the most incessant labour for a period of fourteen months. The great perseverance and labour required in the whole of this undertaking, may be conceived when we consider that the boring instrument was 548 metres, or upwards of 1798 feet in length, this being the total depth of the tube itself, which is lined with copper, with the exception of the first 20 feet from the surface. The water rises 20 metres, or 6[illegible] feet above, and falls into the conduits placed to receive it. At the surface of the ground it yields 2200 litres, or 581 gallons

minute, at an elevation of 20 metres it gives 1800 litres, and at 26 metres, from 1400 to 1600 litres. Water from the well at Grenelle will rise to the top of the highest house in Paris, and it has now been ascertained that throughout the basin of the Seine, and adjoining department, Artesian wells may be formed wherever the elevation of the soil does not exceed that of the Plain of Grenelle by 131 feet. It is currently reported that M. Arago has recently been investigating the causes of central heat, &c., as connected with Grenelle, and that he is now enabled to tell the depth of the well by the temperature of the water. We hope that the result of so interesting a subject will be soon published, particularly as coming from such authority as Monsieur Arago. We are glad to be able to state that the works at Grenelle have been of late carried on with increased assiduity. The tube, which was collapsed by the force of the water, has now been removed, and is at present to be seen at the works. In consequence of this being the bottom tube, great difficulty was experienced in its removal, which, however, has been finally accomplished, and the one which is to replace it is so arranged, that failure in this respect will be entirely obviated. The instrument requires four hours to draw it up and let it down.

SHORT NOTES.

TEST OF THE PRESENCE OF SALT IN BUILDING STONES.

THE simple yet important means about to be described, for detecting whether building-stones have been saturated by sea water, arose out of the following circumstances. A contractor being engaged in the construction of a harbour, where several feet in depth of rock had to be excavated from a considerable area, which was covered by the sea at high water, the stones which were excavated from below this level became mixed with others, which had never been in contact with the sea water. In proceeding to use the stone for building purposes, it was necessary to separate those which had been saturated with salt water from the others, because it was known that the former would attract moisture from the atmosphere, and would consequently be liable to split from the action of frost. Now, when the stones which had been excavated from under water were first taken up, and for some time while they were yet wet, it was enough to distinguish them from those which, never having been touched by the water, were perfectly free from salt; but when the whole became dry, this distinction was lost, and all the stones were confounded together. In this difficulty, an eminent experimental chemist, after a little consideration, suggested that the application of nitrate of silver would detect the presence of the salt. This was accordingly tried on different specimens of stone, and it was found, when applied to stones which were free from salt, that the acid solution simply effervesced with the lime which they contained, and when the effervescence was over nothing remained but a moist spot. When applied, however, to stones which had been saturated by salt water, the effervescence took place as before, and the spot where the stone was touched with the nitrate was immediately covered by a small white flake, which indicated the presence of the salt.

This effect probably took place from the combination of the nitric acid with the soda of the salt, in consequence of which it separates from the silver, and allows the latter to be deposited on the surface of the stone. The solution of nitrate of silver may be made with one part of nitric acid to two or three of water, and a small coin, as a sixpence or a fourpenny piece, will be sufficient for a quarter of a pint of the fluid. With this quantity, many hundred blocks of stone may be tested; and no one who may have occasion to try the experiment can fail to be struck with the distinctness, simplicity, and perfection of the test. The same solution ought to be employed to test the presence of salt in sand and other substances.

PLANOGRAPHY.

Mr. Denton has presented a petition to the House of Commons, complaining of the confusion and unintelligibility of Mr. Macneill's system of planography, as applied to railway sections, and praying that the standing orders may be so altered, that engineers shall be required to deposit models exhibiting the situation and levels of proposed lines, instead of plans and sections.

RAILWAY PROSPECTS.

FROM A LETTER TO BRITISH CAPITALISTS, BY G. S. WRIGHT, C.E.

THE GREAT WESTERN RAILWAY.—In June, 1840, when but a comparatively small portion of this line was opened, the price of the shares reached 108½, or 43½ premium. In June, 1841, when a longer portion was opened, and the weekly receipts were much increased, the price was only 95, or 30 premium; and in June, 1842, when the receipts for the first six months, (£307,411 9*s.* 2*d.*) are nearly double the amount taken in the first six months of 1841, (£187,780 16*s.* 2*d.*) the price is only 88, or 23 premium. The dividend now paying by this line, is 6 per cent. per annum; but as a balance nearly equal to 1 per cent. more, £10,937 5*s.* 1*d.*, remained undivided at the last audit, and the traffic is greatly increasing, and the expences materially diminishing, (the expences in the first half of 1841 were 44.9 per cent., and in the second half, only 37.3 per cent.), there is every reason to expect, that a larger dividend will be declared at the next meeting, and there is every promise that the returns will steadily increase, until they yield a dividend of 10 per cent. per annum, or higher. It is a remarkable anomaly in this railway, that the *half* shares do not bear a proportionate price to the *whole* shares, although they participate proportionately in the dividend. The last dividend on a whole share, (£65 paid) was 39*s.*, and on a half share, (£50 paid) it was 30*s.*, which sums are strictly proportionate; but while the whole shares are at 23, the half shares are only at 11½ premium. In the proper proportion, the half shares should be at 17 to 18 premium, *e. g.* If £65 : 23 :: £50 : 17$\frac{8}{13}$. But the principal object I have in view, is to shew that railway stock yields a better return for capital than funded property. The present price of 3 per cent. Consols is 91, which yields an interest of £3 6*s.* per cent. per annum; thus—if £91 : £3 :: £100 : £3 6*s.* But the present dividend of 6 per cent. per annum, on the Great Western stock, and which is fully realized by the *original* shareholders, yields an interest of £4 8*s.* per cent. per ann. on capital outlaid by purchasers of shares at their present price, *e. g.* If £88 : £3 . 18*s.* :: £100 : £4 . 8*s.* $\frac{48}{88}$, and to purchasers of the half shares, the return is greater, by reason of the disproportionate price of the shares noticed above. This is the result according to the present dividend, but as other lines in connection with this are extending, and the traffic largely increasing, there is no doubt but that the dividend must soon much exceed 6 per cent. A great progressive increase of traffic up to a certain extent, may be depended upon in all leading lines of railway; witness the London and Birmingham, on which, as the auxiliary traffic has developed itself, the dividend has increased to upwards o 2 per cent. per annum, and may probably increase still more. The Liverpool and Manchester, and Grand Junction, are also cases in point, confirmatory of this view. Another source of increased revenue may also be found in the diminished expense, at which, as experience has been gained, all the leading lines have been worked.

THE LONDON AND BIRMINGHAM RAILWAY.—This railway being one of the earliest constructed, and having been now some years in full operation, its capabilities are well developed, and the consequence is, a good dividend *nominally* of £9 10*s.*, but *really* of £12 15*s.* per cent. per annum. The dividend of £9 10*s.* is payable on the *full amount* of the shares, and as the whole sum has not yet been paid up on the whole, or on the quarter shares, hence the larger per-centage upon the amount actually advanced. Such are the benefits accruing to the original shares holder. To the present purchaser, the market price of the whole share is £178, and upon this sum, the dividend of £9 10*s.* is equal to £5 6*s.* per cent. per annum, on the amount invested, thus—

If 178*l.* : 9*l.* 10*s.* :: 100*l.* : 5*l.* . 6 $\frac{144}{178}$.

and as the interest derived from 3 per cent. Consols is, as before stated, 3*l.* 6*s.* per cent. per annum, on the money invested, shares in the London and Birmingham Railway, yielding 5*l.* 6*s.* per cent. per annum, shew an advantage of 2 per cent. per annum, and it must be borne in mind, that stocks already yield their maximum rate of interest; while, as the Chairman of the London and Birmingham Company hinted at the last meeting, the present amount of dividend is by no means to be regarded as the maximum of the Company's prosperity, and as new feeders are continually opening, there is every reason to expect increased dividends hereafter, though not to so great an extent in this longer established line, as in those which are more recently opened. The total receipts of this railway for the first six months of the present year, have exceeded those of the corresponding period of last year by about 8,000*l.*; being 390,184*l.* 11*s.* 10*d.*, against 382,452*l.* 16*s.* 1*d.*

The London and South Western, or, Southampton Railway.—This railway has also now been open the whole way, long enough for the traffic upon it to be pretty well developed, and, accordingly, the dividend already amounts to 7*l.* 14*s.* 3*d.* per cent. per annum, on the original outlay, which, at the present price of 61*l.* per share, is very nearly 5 per ct. per annt. upon money invested in the purchase of the stock. The traffic upon this line has increased more in proportion during the half year just ended than that of the London and Birmingham, the receipts having been 134,362*l.* 7*s.* 3*d.*, against 122,766*l.* 9*s.* 7*d.*, for the corresponding period in 1841. There is every prospect of an extension of the traffic on this railway, from the increase of passengers arriving and departing by the numerous steam vessels connected with Southampton, and when the docks now forming there are opened, which they will shortly be, there will probably be a considerable traffic in goods.

The London and Brighton Railway.—This line has been much injured in public estimation by having been badly managed by its directors, and by a series of misfortunes, partly on its own, and partly on the Croydon line. These causes have tended to depress the shares, which are now below their real value, the price of a £50 share being only £35. To any one, however, who watches the progress of these works, it must be obvious that the Brighton Railway will, during the present year, yield a remunerating return to the original shareholders, and a very handsome one to those who have purchased them at the price now current. The receipts have already this year (*i. e.* for the first six months) amounted to £60,000, and this large sum has been taken notwithstanding the discouragements to travel on it during the earlier months of the period, by the slips on the Croydon line, and notwithstanding the season, which has been that of the least traffic between London and Brighton. As the year advances, the traffic will greatly increase, and there is every probability that during the next six months it will reach £100,000, making a total for the year of £160,000. This alone should suffice to pay a dividend of 5 per cent. per annum on the capital outlaid; but, besides this, there is the accumulated traffic of last year still undivided, and which must amount to nearly £50,000. There is also still to be received from the London and Dover Railway a sum of about £300,000, which will either have to be returned to the shareholders, or be applied to pay off loans and liabilities, and thus diminish the capital outlay and increase the dividends. It appears to me that the original shareholders may now safely reckon upon at least 5 per cent. per annum for their capital, which, to purchasers at the present price of the shares, will yield 7 per cent. per annum; and as the traffic developes itself, and auxiliary lines are opened, the returns may be expected to increase to a greater extent. The loan notes (£10 each) of this railway form a very favourable medium of investment. Interest at the rate of 5 per cent. per annum is guaranteed to them for three years, at the expiration of which period they will be paid off, or the holder will have the option of converting four of them (£40) into a share of £50. Should the shares at the end of three years be only at par, this will be a bonus of 25 per cent.

The Northern and Eastern Railway.—This line of railway is comparatively little known; but it is one of the soundest, best-conducted, and most promising of all the railways leading from the metropolis. The line of country through which it passes is remarkably well-adapted for a railway, being very level, and for a considerable part not very valuable land. The directors, moreover, are men of business; and profiting by the experience of other companies, have avoided some errors and extravagances into which many of their brethren have fallen. The consequence of these advantages has been, that this line of railway is one of the cheapest and best. At present it extends only to Bishops'-Stortford, but will probably ere long be continued to Cambridge. The length of the line is only 32¼ miles; and, as it has been opened the whole distance less than three months, the traffic by it cannot yet be considered to be nearly developed. The receipts go on steadily increasing, being, during the first six months of 1842, more than double the amount taken in the corresponding period of 1841 (28,287*l.* 16*s.* against 14,036*l.*); and there is no doubt they will amount to from 40,000*l.* to 50,000*l.* during the present six months. The shares are 50*l.* each, only 45*l.* being paid up, and the present market price is 39*l.* per share. The dividend paid out of the earnings from June to December 1841 was equal to 3*l.* 15*s.* per cent. per annum, and this will probably be increased to 5 or 6 per cent. per annum at the next declaration, and to 7 or 7½ at the following one. The last dividend was equal to 4*l.* 5*s.* per cent. on the present value of the shares; and, assuming that the next dividend will be only at the rate of 5 per cent. per annum on the amount paid up, this will be equal to 5*l.* 14*s.* per cent. per annum on the present cost, viz. 39*l.* It is quite extraordinary that so sound and prosperous an undertaking should remain so depreciated in value, and that its shares are not at or above par, may probably be attributed to the circumstance, that about 3000 forfeited shares are to be issued to the shareholders on the 6th July, which has the effect of depressing their value for the moment. These will, no doubt, be all taken up (28,000 new shares of the London and Dover Railway, issued about three months ago, were all taken up at once), and the public will then, probably, appreciate this undertaking at nearer its value.

London and Dover Railway.—This line is open only as far as Tunbridge at present, but will be completed to Headcorn in August, to Ashford in December, and to Dover in 1843. This railway also passes through a very favourable country, and has been constructed very well and very economically. The shares are of 50*l.* each (and the whole amount is paid up), but at present they are to be bought at 25*l.* each, notwithstanding they bear interest at the rate of 4 per cent. per annum on the whole amount paid up, which of course is equal to 8 per cent. per annum upon the present price. The line has been opened only a month; and though the receipts go on steadily increasing, yet it is impossible to form an accurate calculation of its capabilities, until there is more experience of it. The anticipations of the directors and engineer are very sanguine, and apparently not without good grounds. There can be little doubt but the original shareholders will hereafter be remunerated for their capital outlaid; and to purchasers at the present price of 25*l.* for a 50*l.* share, the investment must a splendid one. The engineer of this railway, Mr. Cubitt, lately gave it as his opinion, that the undertaking would pay the shareholders if it were never opened further than Tunbridge; and when it comes to take in the Maidstone, Hastings, Rye, Folkstone, Sandgate, Hythe, Romney, Dover, and Deal traffic, the receipts will be very large. The line intended to be constructed by the French government from Paris to Calais, will also much increase the traffic along the London and Dover line, and that with the most valuable passengers, those, namely, going the whole length.

London and Blackwall Railway.—This railway is another remarkable instance of undue depression in the market price of shares, after having been over-estimated. In June, 1840, before the railway was opened, the 25*l.* shares (20*l.* then being paid up) were at 22, or 2 premium. In June, 1841, when the receipts averaged about 900*l.* per week, the 25*l.* shares (the whole amount being paid up) were at 18*l.* or 7 discount. Now, when the receipts are averaging 1,100*l.* per week, and are just beginning to be largely increased by the carriage of goods, and by an auxiliary steam-boat traffic, the shares are at 9*l.* 10*s.*, or 15½ discount, a price very far below their real value! For the revenue to be derived from carrying goods to and from the docks is susceptible of a very large increase, and this will be a source of income not only during the summer, but during the winter also; and from the greater facility, cheapness, and expedition with which goods can be thus conveyed, this traffic must, by degrees, be concentrated upon the railway. The receipts for the half year just terminated amount to about 20 per cent. more than for the corresponding six months of 1841, being 20,202*l.* 6*s.* 5*d.* against 16,686*l.* 14*s.*; and it must be borne in mind that the arrangements for andying goods have been completed only within the last month or two, scarrhat those for an auxiliary traffic from steam-boats are much extended this year, and are likely to be carried further. It may still, however, be some time before the *orygival* shareholders receive a remunerating interest for their money; but, to purchasers at the present extraordinary low prices, the interest yielded for their outlay—now that the railway is getting into full operation—must be very handsome. At the half-yearly meeting held in February last, the Chairman of the Directors gave it as his opinion, that the railway is competent to carry five times the traffic which has been brought upon it, and that it has not yet obtained one-half the winter traffic, nor probably one-fourth of the summer traffic, which it is destined to have. There is every probability that the price of this property will advance nearly 100 per cent. within one year from this time. It was stated at the meeting alluded to that this railway has carried three millions of passengers without an accident.

The Eastern Counties Railway.—This line is also depressed much below its real value, the present price of a 25*l.* share (23*l.* paid) being only 9*l.* The portion at present opened is only 17½ miles; but with even this small portion in operation, a revenue was derived last year, which

paid a dividend of 5 per cent. per annum upon the present price of the shares, and as the line will be completed to Colchester (a distance of 51 miles) in the course of this year, a very large addition may be expected to the receipts.

Upon a careful consideration of the above details, it will be evident that those lines of railway which have been judiciously selected, as affording materials for a large traffic, and which have been opened long enough to admit of that traffic being well developed, have proved a very profitable investment to the *original* shareholders; while others, which pass through a district affording less materials for traffic, or which have been opened only recently, are either paying their original shareholders a fair interest for their outlay, or give good promise of doing so forthwith. But whatever may be the result to the original shareholders, it is evident that to the capitalist who invests in these properties at their present prices, the returns will be greater than he can obtain from other property which is generally accessible, and which affords the like security; and that there is every reason to expect a steady increase in the returns, for hitherto railway traffic has been progressive even in those lines which have been long open, and in many of them it seems capable of an indefinite addition.

The present low prices of railway shares are, no doubt, to be attributed partly to the over-estimate of them in 1840, and to the re-action consequent thereupon. Another cause may be traced in the depression of the times, which does not admit of nearly so many investments being made in them by the middle classes as formerly. This is just the opportunity when the wealthy capitalist may step forward, and invest with the greatest advantage; and the present time, which seems to be marked by the absence of speculation, which, when it exists in activity, generally gives a fictitious value to property, appears to be very favorable. The capitalist who thus invests will not only be securing a better interest for his money than is yielded by any other stock which offers the like security, but will also encourage the most important public works of the age, and indirectly cause their increase and extension, until the country is intersected with them, and enabled to derive all the advantages which their existence is calculated to convey.

London, 27th June, 1842.

AMENDED INSTRUCTIONS OF THE CHURCH BUILDING SOCIETY.

(*Continued from page* 222.)

10. *Tower and Spire.*—The usual place of the tower, in a church without transepts, is at the west end; or it may be placed about the middle of the side.—If funds are scanty, it is better to leave this part of the church to a future period, than to attempt its immediate completion in an inferior manner.

When the tower contains more bells than one, the timbers of the bell framing or floor should not be inserted into the main walls; but should be supported either on set-offs or on corbels.

11. *Gutters.*—Where necessary, to be *most carefully* constructed to carry off the rain and snow into the perpendicular pipes, which are best of cast iron, cylindrical, and placed an inch or two at least from the wall, so as to admit air and keep it dry.

Dripping eaves projecting very far do not in all cases supersede the necessity of gutters and pipes, even in very sheltered situations; but in exposed places, eaves-gutters, and rain-water pipes will be absolutely necessary to prevent the wet being driven against the walls, and thus rendering the building damp.

Eaves-gutters may be made of cast-iron; but, unless very skilfully cast, they will not preserve their level.

The lead for gutters must not be less than eight pounds to the foot.

Lead gutters must not be less than twelve inches wide in the *narrowest* part, with drips at proper intervals; each drip two inches deep at the least, and the fall between the drips not less than one inch and a half in every ten feet.

Outlets to be provided in parapets to carry off the overflowing occasioned by rapid thaws or otherwise.

Drains on the roof should be protected by coverings, as it prevents the melting snow from congealing in the gutter, and thus obstructing the water-course.

Drains should be formed at the feet of all the rain-water pipes.

12. *Ventilation.*—Ventilation cannot be always completely effected by windows alone, without incommoding the congregation. In such cases foul air may be expelled at or near the roof, either by horizontal or perpendicular channels or tubes.

Where there is a ceiling, apertures should be made in it for the proper ventilation of the roof.

All the original provisions for the ventilation of the building must be carefully looked after, and the apertures kept open.

13. *Chimneys.*—If any be required, the utmost care must be taken to render them safe from fire. They should never be brought within eighteen inches of any timber. They should be as unobtrusive as possible, but not disguised under the form of any ornamental feature of the building.

14. *The Lord's Table*—Should be raised two or more steps above the floor of the chancel, which should itself be raised a step or two above the floor of the nave. Where the rails do not extend across the chancel, no seats should be allowed between the rails and the north and south walls; and as much room as possible should be left about the rails for the access of communicants.

15. *Font.*—To be fixed at the west end of the building, or as near as convenient to the principal entrance, but not so as to be under a gallery. Care to be taken that sufficient space is allowed for the sponsors to kneel. The font to be of stone, as directed by the Canon, and large enough to admit of the immersion of infants. To be provided with a water-drain.

16. *Reading-Pew and Pulpit.*—The reading-pew should not be so elevated as to resemble a second pulpit; and both reading-pew and pulpit should be so placed as to intercept the view of the east end as little as possible from the body of the church.

17. *Seats.*—The seats must be so placed as that no part of the congregation may turn their backs upon the altar. There must invariably be an open central passage up the whole length of the church, from west to east. No square, or round, or double pews can be allowed, and as few pews as may be. Much accommodation is gained by the adoption, instead of pews, of open seats with backs.

The distance from the back of one seat to that of the next must depend in great measure on the heights of the backs and the arrangements for kneeling. Where the funds and space admit, convenience will be consulted by adopting a clear width of *three feet*, or even *three feet four inches*; but the width of *two feet six inches* in the clear may be allowed if the back of the seat be not more than *two feet eight inches* in height. This height is in all cases to be preferred, both for convenience and for appearance. If a greater height be adopted, the distance from back to back must not be less than *two feet eleven inches* in the clear. There should not be any projecting capping on the top of the backs. Means for kneeling must in all cases be provided. Hassocks are to be preferred to kneeling boards, especially where the space is narrow.

Twenty inches in length must be allowed for each adult, and *fourteen* for a child. Seats intended exclusively for children may be *twenty-four* inches from back to front.

18. *Galleries.*—None can be permitted in any part of the chancel. Where necessary, they should not enclose the columns against which they rest, so as to break the upright lines of the shafts from the floor to the roof. Wherever placed, they should, as much as possible, be made to appears as adjuncts and appendages to the architectural design of the interior, rather than as essential parts or features of it. The Society will not sanction any plan involving the erection of a gallery, unless in cases where it is distinctly shown that no room is unnecessarily sacrificed, by inconvenient arrangements, on the floor.

19. *Vestry.*—The vestry should have access to it from without.

20. *Finishings.*—Wall wainscoting, or wood linings to walls, to be avoided wherever convenient. Wood linings to walls confine the damp, and frequently occasion dry-rot. For the same reason cement skirtings are to be preferred to wood; particularly on the ground floor. Where the linings to the walls are of wood, holes should be perforated under the seats to allow the circulation of air. As it is scarcely possible to prevent rot if any wood is in contact with the walls, the ends of seats next the walls should be omitted, and cement, painted, be substituted.

21. *Exciseable and Customable Articles.*—Architects are particularly desired to take care that an *accurate account* be kept of the quantities of customable and exciseable articles used, where the expense of enlarging or building a church or chapel will amount to £500, or upwards, such as may be duly certified or verified by affidavit.

INSTITUTION OF CIVIL ENGINEERS.

COMMUNICATIONS.

Description of the Menai Lighthouse. By D. P. Hewett, *Grad. Inst. C. E.*

The Menai Strait is peculiarly fitted for a harbour of refuge for vessels entering the Rivers Dee and Mersey from the north, and the increasing

number of ships frequenting this navigation, as well as the insufficiency of its beaconage, rendered it desirable that the entrance should be distinctly marked; the Corporation of the Trinity House accordingly decided, in 1834, to effect this object by the construction of a lighthouse, to be situated on a sunken rock about 200 yards from the Anglesey coast on the west side on the entrance, which is divided by the Puffin Island into two channels, defined by a beacon and two buoys.

The principal novelty in the construction of the lighthouse is the base, which, instead of diminishing, like the Eddystone, with a regular curve, recedes by a series of rectangular offsets; the object of this form of structure is to break the force of an impinging wave, and prevent the whole effect of its shock being thrown upon the upper part of the building, as it is when guided up by the curved surface.

The building, which was designed by Messrs. Walker and Burges, is a handsome circular tower 75 feet high, 40 feet in diameter at the base, and 20 feet 6 inches diameter at the top, terminated by a castellated parapet, and entirely constructed of Anglesey marble. The base of the building is solid to the height of 22 feet 6 inches from the rock, diminishing at intervals of 2 feet 3 inches by offsets of 9 inches each, up to 6 feet 9 inches above highwater-mark, where its diameter is 22 feet. On that level is the entrance doorway (which is accessible by steps cut in the base stones). The interior contains six floors, forming rooms for the use of the light-keepers, stores, &c. Every precaution has been taken to render the exterior joints of the courses water-tight; each stone is secured to that below it by a slate joggle, and two oak trenails, passing entirely through it, and entering 8 inches into the lower stone. On the upper bed of each course of stones is a projecting fillet, which fits into a corresponding groove in the under side of the course placed upon it, in order to prevent the water from being forced between the courses. The two upper courses project internally and externally to form a gallery which supports the parapet and the lantern, the foundation and the framing of which are of cast-iron. The wall diminishes gradually in thickness from 6 feet 9 inches to 2 feet.

The communication describes minutely the construction of the floors, the partitions, the stairs, the lanterns, &c., and the proportions of the materials for the mortar, which consisted of three measures of sand, one of ground lime, and one of Italian pozzuolana.

The light is a stationary, red, dioptric light of the first order, withou mirrors. The burner consists of four concentric wicks, of which the largest is 3½ inches diameter; its ordinary consumption of oil is one pint per hour. The various bearings are given from which the light is visible at sea. After deducting all expenses, the surplus revenue derived from the light dues, during the year 1840, is stated to have been £383 13*s.* 3*d.*

The lighthouse is connected with the shore by a foot bridge, which consists of a platform 2 feet 3 inches wide, supported upon a series of iron columns placed 10 feet apart, secured into the rock and strengthened by stays. This slight construction has withstood the violence of the waves for three years.

The paper notices the buildings which have been erected on the shore for the residence of the light-keepers, and then proceeds to describe the beacon before alluded to, which points out a dangerous ledge of rocks on the opposite side of the channel. It consists of a cone of masonry, 20 feet in diameter at the base, and 37 feet high, surmounted by a staff and globe rising 13 feet above the apex of the cone. The globe, which is 4 feet diameter, is formed of copper bands, and is 36 feet above high-water mark.

The whole amount expended in these different constructions is stated to have been about £12,800.

The communication was illustrated by a series of detailed drawings and a chart of the straits.

Observations upon the Sections of Breakwaters as heretofore constructed, with Suggestions as to Modifications of their Forms. By Lieut. Col. H. D. Jones, *R. E., Assoc. Inst. C. E.*

This communication is the result of several years' observation of the effect of storms upon the sea faces of breakwaters and piers: those principally alluded to, and of which drawings were exhibited, were Plymouth, Kingstown, Howth, Ardglass, and Dunmore; a section was also given of the sea wall of the Kingstown Railway, and of the mole of St. Jean de Luz.

The mode of building with "Pierre perdue" appears to have been brought into notice about the time of Louis XV., when the cones at Cherbourg were sunk and filled with stones as a foundation for a wall; since then the general method of constructing sea-defences has been to throw down masses of stone, allowing them to form their own angle, subject to the effects of the sea in giving them a greater or less slope. In many instances this rough foundation has been paved down to below the low water-mark with squared blocks of stone secured with much care, and above this a wall is built of solid masonry, generally with a considerable slope on the sea face.

The author contends that the system of assimilating the sea face of breakwaters to the form of the shore at low water is erroneous, because the sea shore is the line of least or non-resistance, not opposing, but yielding to the sea: he asserts that, as far as he can ascertain, no pier or breakwater constructed with a sea slope has been found to resist the effects of storms without considerable repairs and expense being subsequently required. He then gives his observations upon the several sections, and states that the waves have the most violent effect at about half-tide, hence the stones at that line are first disturbed, and then are carried down into the deep water: to parry this evil nearly 200,000 tons of stone have been deposited on the foreshore of Kingstown Eastern Pier,—yet more must still be added. Similar additions have been repeatedly made to Plymouth Breakwater with no better effect. At Dunmore iron chains have been fixed in the face of the walls to secure them. At Howth a slope of 3 to 1 has been found insufficient. At Ardglass the pier head and lighthouse have been washed away. From these and numerous other examples it is argued that piers in exposed situations with a considerable inclination of the sea face do not resist the violence of the waves, whereas there are many instances of upright walls having resisted perfectly. As instances of this, Old Dunleary Pier is adduced as being nearly perpendicular, yet never having been injured during a long series of years, although quite as much exposed as the New Pier, now called Kingstown: Kilrush Pier, although not built of heavy materials, has resisted all the shocks of the heavy seas which break upon it from the Atlantic.

From these considerations Colonel Jones proposes upon the "Pierre perdue" to rise a perpendicular wall from a little below the level of low-water spring tides: this form, he contends, would resist the upward pressure of the sea upon the broad bases of the stones, and prevent their being removed. He argues that although the proposed walls would require to be built with square stones, instead of "Pierre perdue," that the cost would not be greater than at present, as the area of the section of his proposed wall if applied at Kingstown would be only 4860 square feet, whereas the sectional area of the present pier is 10,085 square feet. The French appear to have partially adopted this form at the new works at Cherbourg; but he considers this mode of construction objectionable, inasmuch as it leaves in front of the outer face that part of the breakwater which is most subjected to injury.

An extensive series of drawings, containing the plans and sections of existing breakwaters and piers, showing the injury sustained from storms, accompanied the same.

Colonel Jones explained by the various sections of breakwaters shown in the drawings, the changes of forms and the additions to their cubic content which had been made at different periods in consequence of the violent action of storms.

The Plymouth Breakwater has had its form altered three times; each time the base has been extended and the sectional area increased.

At the Howth Pier the sections showed three distinct forms assumed by the mass of materials, in consequence of the varied action of the waves. The damage done is now so extensive, that the sea threatens to make a clear breach through the works.

The sections of the Kingstown Pier showed the original form to have been a slope of 4 to 1 and 5 to 1, covered with heavy pitching which had been repeatedly torn up, and some of the stones weighing 10 tons were carried to considerable distances: an external mole of rough work containing nearly 200,000 tons of stone which had been deposited upon the foreshore was almost washed away; while the toe of the work beneath low-water mark, although at a greater angle than the other parts, remained undisturbed.

At Dunmore Harbour, although the long glacis with a slope of 5 to 1 is protected by pitching composed of square stones of from 2½ to 6 tons weight, and above 12,000*l.* has been expended, it has received very extensive damage.

Many other cases of injury to sloped works were mentioned, and it was stated that from these examples, coupled with observations upon some ancient piers in Cornwall and other exposed situations, which although built of rough materials and with a nearly vertical sea face, had resisted the action of heavy seas, the Shannon Commissioners had determined to try, at Kilrush, a sea wall with a very slight inclination, and up to the present time it had sustained no injury, although previously the slope work had been destroyed.

Colonel Jones, being convinced of the superiority of this form, had devoted much time to observations of the action of the waves upon works of all kinds, as well as to the various modes of using the materials composing the sea-walls; and he felt assured that if the stones were of an average size, square-jointed, and well laid, even without cement, forming an almost vertical wall of moderate thickness, springing from a point as much below low-water mark as could be conveniently attained, the work would be more durable. "Béton" (concrete) was now much used in France for the construction of sea defences: it was generally done by building caissons of ashlar, filling them in solid with "Béton," and then caulking all the ashlar joints with oakum: this kind of work was very durable.

In answer to a remark by General Pasley, Colonel Jones believed that the greatest injury was done by the receding waves, particularly if the joints of the work were not well closed.

Mr. Rennie took a hasty review of the moles and breakwaters mentioned by the early writers, as being thrown out for the purpose of forming harbours; Vitruvius particularly described, among other similar works, a mole constructed with a kind of concrete composed of "pozzuolana."

Mr. Rennie contended that engineers were not in error in taking as their guide the natural inclination of the sea-shore opposite the situation where the breakwater was intended to be placed: it would be found in following the coast of England from the perpendicular primitive cliffs of Cornwall to the flat shingle beach of Norfolk, between which places is found almost every variety of geological formation, that the profile of the sea-shore differed according to the material of which it was composed and the peculiar action of the sea upon it from local circumstances. It had been shown that the force of the waves acted more prejudicially upon the point above low-water than below it; that the work would stand at a great inclination at the latter point, indeed that it was rarely injured even when all above it was carried away; that if the water was deep, the action of the waves would extend deeper: all these and many other points required to be considered in fixing upon the slope for any sea-wall; and therefore he could not accord with Colonel Jones's views in adopting an arbitrary form for all situations, without considering the exigencies of peculiar localities. He had been particularly struck with the regularity of the slope assumed by the materials at Kingstown pier after a storm: but in that and all similar positions, the inclination of the face varied with circumstances and with the degree of violence of the action of the waves.

Among the many arguments against the proposed perpendicular form, might be mentioned the increased expense; for if built of squared stones below low-water mark, the work must be done from a diving-bell; and also that the form is objectionable for a pier, as the wave is thrown up in a mass, instead of expending its force in rolling over the long slope of the fore-shore.

Mr. Telford had abandonded vertical sea-walls on these and other accounts.

Mr. Vignoles agreed to a certain extent (but not fully) with the form proposed by Colonel Jones: he believed that although the construction might be rather more costly, it would be amply compensated for by the greater durability: and he saw no difficulty in doing the work; the proposed plan he understood to be by commencing the foot of the wall only at such a depth below low-water as should prevent the violent action of the waves upon it.

At Ardglass the upper portion only of the pier is destroyed; all that part below low-water remains perfectly sound: it is of ashlar of large dimensions, placed from a bell.

Mr. Gordon had seen sections of the works which were commenced for forming a breakwater at Madras: the materials reached at the highest point to within about ten feet of low-water, and amidst the violence of the surf of that coast the work stood undisturbed at an angle of 45°: it was composed of "pierre perdue."

At Algiers the French engineers had used extensively masses of concrete (blocs de béton), but at first they were displaced and destroyed by the force of the seas; the cubic capacity of the masses had however been increased to the extent of 2 metres square by 3 metres long; they were floated out and allowed to drop into their places from slings; and now they succeeded perfectly. The upper part of the work is intended to be of concrete cast in caissons, the section below low-water is at an angle of 45°, and above it like an ordinary quay wall with a curved "batter."

In allusion to the depth of the wave and the power of its action at Madras, Sir John Robison said that, during a violent storm, a quantity of pigs of lead had been cast ashore near the fort, and it was proved that they had come from a vessel which had been wrecked at more than a mile from the shore during the siege by La Bourdonnaye.

The President observed that at the Plymouth Breakwater the largest blocks (some of them weighing from 6 to 8 tons) and the greatest number have been washed from the sea face over into the Sound; the square stones with which the fore shore is paved are placed with the utmost care, and little comparative injury has been done since that method has been adopted. Engineers now generally recommend a deep paving of stone in bond courses as the best mode of construction. In order to insure the stability of the lighthouse now erecting at the extremity of the Plymouth Breakwater, a foundation of squared stones has been carried up from the natural rock and an inverted arch turned below the level of the top of the work; and for its further security a buttress is now thrown out upon the foot of the south slope, in order to prevent the stones from being carried away.

It is evident that if the materials are deposited at an inclination, any portion being displaced is only carried down, to where, although strictly speaking it may not be wanted, it must nevertheless assist in consolidating the mass; and the vacant spaces can easily be filled up. Under similar circumstances a perpendicular wall would suffer more severely, and probably would have fallen entirely. He therefore considered that in situations like that of the Plymouth Breakwater, which was exposed to a heavier sea than Cherbourg, a long slope for the face was essential. Still there were situations where the form proposed by Colonel Jones would no doubt be available, and the members were much indebted to him for the suggestion, as also for the valuable observations shown in the sections accompanying the paper: he hoped that he would continue them, and that other members, who had equal opportunities and less arduous duties to perform than the author, would give the Institution the benefit of their observations.

(To be continued.)

THE PRACTICAL AND SCIENTIFIC ASSOCIATION FOR IMPROVED STREET PAVING.

The Committee granted the use of their rooms in Vere street, on Wednesday, 10th August, to Mr. Rodway, the Patentee of the Concave Horse Shoe, on which occasion there was a numerous attendance of the Committee and their friends, of veterinary surgeons, omnibus proprietors, and scientific gentlemen, invited by cards from the Committee, to procure a more extensive inquiry into the merits of the Concave Horse Shoe than it had theretofore been subjected to,—also to invite the expression of the opinions and suggestions of the public, on a subject which is considered to be of the greatest consequence in connexion with the very extensive additions of wood pavement now making, and in progress of being executed, in the crowded thoroughfares of the metropolis.

The proceedings were, as we have stated, *purposely* intended to court public disquisition, in order to ascertain how far the Patent Shoe would really tend to prevent horses from slipping on wood pavement, the Committee having expressed its conviction that nothing can more materially impel the onward progress of wood paving than an established improvement in the horse shoe, and its desire that the best tests of which circumstances will admit, should be applied to prove or disprove the advantages which the Patentee claims as exclusively belonging to his invention.*

The Patentee having been called upon by Captain Ibbetson, the Chairman, proceeded at considerable length to explain the defects of the common shoe, and of the present mode of shoeing; and the advantages suggested by the use of the Patent Concave Shoe. The illustrations were made by the exhibition of a piece of the patent rolled iron, as supplied for the purpose of making the shoe,—a shoe in its simple form, —and one fixed to a horse's hoof. The peculiar adaptation of this shoe to wood pavements was exemplified by its application on the various specimens of wood paving collected in the Museum of the Association, and completely established the fact that the concavity in the formation of the Patent Shoe enables the horse to take a perfect hold on wood pavement. Mr. Rodway succeeded also in demonstrating to the Meeting, by a variety of interesting remarks on the construction of roads, in reference to the draught and power of horses, that this simple, though highly important improvement in shoeing, must prove a powerful aid in the progress of wood paving, by disposing of the only remaining objection to the universal application of wood for the making of carriage ways.

The Patentee, in the course of his observations, dilated at some length on the violation of natural principles in the system of shoeing horses, as now generally practised, and drew some comparisons to show how far he

* Mr. Rodway's Shoe differs from those in common use by having a semi-circular concavity underneath and entirely round it, so that a strong rim is left in front, or on the outside, equal in thickness to the hoof of the horse's foot, and another at the back, or inside, equal to half that thickness.

had succeeded in adapting this necessary auxiliary of art to the natural functions for the protection of the horse's foot in trafficking over made roads; from which it was gleaned, that the formation of the outer and inner rims of the Concave Shoe is adopted with a view to increase (which it is stated it does, in a manifold degree) the hold or purchase of the horse upon the ground, by which also the animal is able to use his limbs with increased confidence and safety. The Concave Shoe is not liable to be thrown—it is lighter—it will not require removing—and it will obviate in a great degree the objectionable necessity of turning up in the winter. These facts are thus made to appear:—first; the shoe is prevented from being thrown, by the nails being driven and countersunk in the concavity, which effectually prevents them from wear, and causes them to last as long as the shoe;—secondly, by taking away the iron that would fill the concavity it is of course lighter to that extent;—thirdly, as the nails cannot become loose, removing will not be necessary;—fourthly, the open heels of the shoe being pressed upon by the weight of the horse, naturally sink into, or penetrate, the substance trodden upon, and by acting as hooks or wedges, enable the horse to tread with firmness and security upon wooden pavement, avoiding, in effect, the use of spikes, or stilts, or calkings, according to the practice of turning up. From these results Mr. Rodway anticipates a very great improvement in the power, and in the general health of horses.

Mr. Rodway having concluded his general exposition, the Chairman requested any gentlemen who were disposed to proceed in the inquiry, by expressing their opinions, or questioning the Patentee. Mr. Dickson, veterinary surgeon, stated that he had shod his horses on the 20th July with the Patent Concave Shoe—had worked them constantly since, frequently over wood pavement, and always without slipping—having been on three weeks, the shoes were not more than half worn. Mr. Dickson said, he had not the slightest doubt of the Concave Shoe being brought into general use, as preferable in every respect to the common shoe. Mr. Woodin had shod his horses with the Patent Concave Shoe. He stated that the shoe wears well—is peculiarly well adapted for wood pavement—is preferable in every respect as a general shoe: in cases of diseased hoofs, or feet, it will require some pains in fitting, as with the common shoe—that he considered its use desirable for the consumer, its application profitable to the smith; and that in respect of draught horses, he (Mr. Woodin) having to shoe a certain number of brewers' horses by contract, had, with the permission of the owner, supplied the Patent Concave Shoe, with advantage to his employer, and he need scarcely add, with benefit to himself.

The Patentee was minutely questioned by several scientific gentlemen present, particularly in the comparative amount of friction of the common and the patent shoe; and from his replies we gathered, that the general use of the Concave Shoe is likely very considerably to decrease the amount of wear and tear of roads; but it is obvious that no data can be depended on for calculations of this nature, until those can be obtained which future experience will furnish. We learn, therefore, with pleasure that the Concave Shoe is to be tested on the principal line of omnibus traffic in the Metropolis.

These interesting proceedings, which included an animated discourse on the physiology of the horse, are to be published in the form of a pamphlet, which we shall probably notice on a future occasion; in the mean time, whether Mr. Rodway may eventually succeed in procuring the general adoption of his Shoe, or whether Mr. Rodway's Concave Shoe is only a precursor to still greater improvement in that essentially important article, it is most gratifying to the friends of wood paving to perceive that one by one all the objections to its general introduction are being satisfactorily demolished.

We hail with great pleasure the formation of a society for the promotion of improved street paving, and are glad to perceive that they are already directing their attention to the discussion of practical points relating to the general economy of wooden pavements.

FOREIGN COAL MINES.

(From the Dictionnaire du Commerce.)

GEOGRAPHY OF THE COALS IN FRANCE—IMPORTANCE OF THE DISTRICTS OR BASINS OF COAL—DESCRIPTION OF THE COALS PRODUCED.—The coal is extracted in France from forty-six coal districts. Of the forty-six districts, the following eight produce the chief quantity of coal extracted in France. They deserve particular consideration on account of their extent,—the number and importance of the beds of coal which they contain,—the nature of the coal they yield,—and the navigable means by which they are or can be conveyed.

1. *The Basin of the Loire, comprising the Mines of St. Etienne, Rive de Gier, &c. &c.* is the most important in the kingdom, from its extent, its position, and the good quality of the coal. The quantity of coal produced in 1835, was 890,000 tons. The total quantity produced in France, was 1,980,000 tons. This basin produced th erere $\frac{44}{100}$ths of the total production.

2. *The Basin du Nord, or de Valenciennes—Coal of Anzin, of Raismes, of Abscon, of Denain, &c. &c. &c.*—The coal-field of the Nord is the continuation of the immense stratum which is worked at Eschweiler, near Aix-la-Chapelle and Rolduc, and is found again at Liege, at Namur, Charleroy, and Mons. The product of all these mines is calculated as being $\frac{37}{100}$ths of the production of France.

3. *The Basin du Creuzot and de Blanzy*—These mines are estimated to produce six and a half hundredths of the total production, that is, 130,000 tons, at 6*s.* 7*d.*

4. *The Basin d' Aubin (Aveyron.)*—This basin produces $\frac{61}{1000}$ths of the total production in Erance. When the navigation of the Lot shall be improved, the coals can be easily extended to the valley of the Garonne and of the Gironde, as far as Bordeaux. In 1835 the production was about 114,000 tons, at 4*s.* 1*d.*

5. *The Basin d' Alais (Gard).*—Coal of Alais. This basin produces $\frac{33}{1000}$ths of the total French production. It has only been worked since 1809, and is one of those on which the country can rely the most. *The developement of our national industry in the south-east of the Kingdom, the progress of Steam Navigation, and that of our Commerce in the Levant, are closely connected with the prosperity of this basin;* but the advantage which it promises will be only realized when it shall have been placed, by means of a railroad, in connection with the chief line of navigation on the Rhone. Certain beds procure coal of a caking nature, suitable, whether used as small or in lumps, to yield coke of a good quality. Others produce a dry coal, which burns without flame or smoke, and which is therefore much sought after by breeders of silk-worms. *When the law of June* 1833, *for authorizing the opening of a railway between Alais, Nimes, and Beaucaire, shall be carried into operation, the use of the coal of Alais can be extended at a moderate price to the neighbourhood of the Rhone, the canal of Languedoc, to Marseilles, Toulon, Narbonne, and Perpignan. It might even be profitably sent to several Foreign Ports of the Mediterranean which are now supplied with English coals. In* 1835 *this basin produced only* 46,300 *tons.*

6. *Basin of Litry.*—The coal of Litry is only about $\frac{8}{1000}$ths of the French production.

7. *Basin of Brassac.*—This mine produces $\frac{10}{1000}$ths of the French production, that is to say, 33,200 tons, at 7*s.* 4*d.*

Basin of Decize.—This mine yields only $\frac{11}{1000}$ths of the amount of the French production.

IMPORTATION OF COAL INTO FRANCE.—In 1835, the quantity imported was about 766,900 tons. Belgium figures in this estimate for $\frac{60}{100}$ths, England for $\frac{9}{100}$ths, Prussia for $\frac{8}{100}$ths, Germany for $\frac{8}{100}$ths, and other countries for hardly any thing. In addition Prussia supplies 400,000 tons of coke.

PRODUCE OF COAL IN PRUSSIAN STATES.

(From Dr. Bowring's Report on the Prussian Commercial Union.)

The production of Coal in the Prussian States, in 1836, was somewhat more than 1,800,000 tons, or about $\frac{1}{5}$th of the estimated annual produce of England. In 1837 it had reached 2,000,000 tons. The imports in 1836 were 67,738 tons; the exports 271,822 tons. There has been a gradual increase in the production of coal from 1832, when the amount was 1,300,000 tons. Of the quantity produced in 1836—

	Tons.
Silesia furnished	560,000
Thuringia	1,300
Westphalia	745,000
Rhenish Provinces	500,000
	1,806,300

A return, furnished by Baron Humboldt, represents the quantity of coals dug in 1837, at 10,393,479 Prussian tons, which represent 2,080,000 Tons English, whose value is estimated at about £560,000 sterling, or about 5*s.* 6*d.* per ton.

COAL MINES OF THE UNITED STATES.

(From Chevalier's Letters on America.)

The mines of bituminous coal in the Chesterfield County, near Richmond, in Virginia, are connected with the James River by a small iron rail-road, applicable for horses only, about 10½ miles long, and which cost

£4,000 per mile, including materials. *Once put on board in the river, the coals are supplied to the neighbouring counties in competition with the bituminous coal of England and Nova Scotia.*

The beds of anthracite coal in Pennsylvania have given rise to a great number of works of much more importance.

At the present day, scarcely any other sort of fuel is used all along the banks, both for domestic and for manufacturing purposes, than the anthracite coal, which is found exclusively in a rather limited district in Pennsylvania, in the mountains situated between the Susquehanna and the Delaware. It is always used with success under coppers, and it has even been applied to steamers in the place of wood.

The extraction of anthracite coal is considerable. *Several canals and railroads have been constructed, or are in the course of construction, for the purpose of conveying it from the mines to the places of consumption.*

The principal lines established and in progress for conveying the produce of these mines, are—

1. The canal of Schuylkill, leading to Philadelphia. The cost has been £640,000, or £7,440 per mile. It yields a net revenue of 20 to 25 per cent., and conveys 400,000 tons per annum.

2. The canal of the Lehigh, from the sources of the Lehigh to the Delaware; 35 miles long; cost £332,000, or £9,480 per mile.

3. The canal lateral to the Delaware; it conveys to Philadelphia the coal which has come by the canal of the Lehigh. It is 48 miles long, and cost £304,000, or £6,320 per mile.

4. The Morris canal. It supplies the New York market with the coal from the Lehigh. It is 97 miles long. It cost £440,000, or £4,520 per mile.

5. The canal from the Hudson to the Delaware. It is 86 miles long. It cost £504,000, or £5,860 per mile.

6. The railroad from Pottsville to Sunbury. Its length is about 35½ miles. It will cost about £240,000, or £6,760 per mile.

7. The railroad from Philadelphia to Reading, in course of construction. It will be about 45½ miles long, and, with the material, will cost about £7,000 per mile.

In addition to these seven great lines, several mining companies have laid down a number of other railways of a smaller size. At the end of 1834 there existed about 132 miles length of these railroads, which cost about £240,000; the length of the seven lines of communication already mentioned is 446 miles, and the cost £2,852,000, making a total of 578 miles, and the cost £3,092,000; or, exclusive of the canal by the Delaware, 530 miles, and the cost £2,788,000.

LONDON ELECTRICAL SOCIETY.

Tuesday, Aug. 15.—A letter was read from Walter Hawkins, Esq. member, F.S.A., F.L.S., &c., suggesting the propriety of the Society's instituting an inquiry into the modes of protection against lightning provided for our churches and open buildings, and publishing some general directions on the subject. A short paper by Mr. Mackrell, member, was then read, describing the method by which he had obtained ferric acid by electrotysis. A paper by Mr. Henry Sotheby was then read, giving an account of the dissection of a gymnotus electricus, together with reasons for believing that it derives its electricity from the brain and spinal cord; and that the nervous and electrical forces are *identical*. The paper was divided into three parts; first, the anatomy of the fish; second, its electrical properties; and third, whether the former afforded any clue to the comprehension of the latter. The anatomical investigation shows that the electrical organs are not super-additions of a peculiar structure, but are the result of an increased development of certain intermuscular septa, which become arranged into tubes running diagonally. The number of tubes in the entire animal is upwards of half a million.

The second division of the subject mainly referred to the now familiar experiments which have established the identity between the phenomena produced by these fish and ordinary electricity. In the third division the author alludes to two genuine facts, that the organ consists of septa, containing albuminous fluid, and that it is supplied by nerves greatly exceeding the wants of animal life; connecting this latter fact with the voluntary discharge of the animal, with the division of the nerves preventing the discharge, with the irritation of the nerves increasing the discharge, the author concludes that the electric force is supplied by the nerves, and is concentrated or made tense by the organ. These are the general features of the paper; it was illustrated with a series of drawings, and also with anatomical preparations of the organ and nerves. The meeting terminated with the reading of Mr. Weekes' Electro-Meteorological Register for July, from which we learn that the thunder storm that caused so much danger in London, did not extend its destroying influence so far as Sandwich.

ABSTRACT OF SPECIFICATION OF THE PATENT

GRANTED TO EDWARD FRANCOIS JOSEPH DUCLOS, OF CLYNE WOOD METALLURGICAL WORKS, SWANSEA, FOR IMPROVEMENTS IN THE MANUFACTURE OF COPPER.

The first improvement specified consists in calcining all sulphurous ores of copper, technically called sulphurets, and other artificial products of the same nature in large kilns, whereby a large portion of the coal and labour required in the ordinary treatment are economized; and the sulphurous acid gas and sulphuric acid formed in the operation, irretrievably lost in the ordinary method, are made applicable to the manufacture of sulphur or sulphuric acid.

Secondly. When the ores have been sufficiently calcined to treat them for the reduction of any metallic oxides they may contain, in a blast furnace similar to those used in the manufacture of iron, with the addition of chambers of condensation and feeding apparatus,—such additions being calculated to insure the collecting of any volatile products which the ores treated may contain,—the earthy matters associated with the ores are fluxed by a proper addition of lime or other substances, according as the chemical composition of the ores to be treated may require.

Thirdly. The mixture of metallic copper with cast iron thus obtained by the preceding operation, is then submitted to fusion and liquidation in a common iron-founder's cupola, modified to insure the liquidation of the two metals.

Fourthly. The black copper from which the cast-iron has been separated by difference of gravity is submitted to refining in the usual way, in the refiner attached to the furnace of liquidation.

Description of the Treatment.

The ores of copper, when ground to the size of one-fourth or one-third of an inch, are mixed with quick-lime in the proportion of two and a half cwts. of quick lime or thereabouts to every ton of copper ore. The quick-lime is slacked thin and mixed with the ore in the same manner and of the like consistence as common mortar. It is then laid on heated floors between two and two and a half inches thick, and cut, as soon as spread, in parallellograms of the same size as common bricks are generally made. The floors are then kept hot for twenty-four hours, when it will be found that the mixture has acquired sufficient solidity to remove the rough bricks so produced to the kiln, where the calcination is to be effected. The doors through which the bricks have been piled being closed and luted, a fire is kindled on the grate of the kiln furnace, until the mass becomes of a dark red heat; the ash-pit door, to which air-slides are fixed, is closed hermetically, as well as the fire-door, and the admission of the fresh air is thus controlled to keep the mass of ore burning at the same temperature, which is also better effected by the regulation of the draught of the escaping products of the combustion, by means of dampers placed on the eduction flues. It is found in practice when the first combustion is over, that it is advantageous to light another fire at a rather increased temperature, and thus more completely obtain the expulsion of the sulphur contained in the ore by the repetition of the above described treatment. The ores of copper, in large lumps not exceeding 2 inches square, may be calcined in prismatic kilns with double grates, with the same arrangement of the kiln described as is necessary for the regulation of the draught, and when sufficiently calcined, may be taken at once to the blast furnace. The ore thus calcined is charged with a sufficient quantity of coal, or coke, or charcoal, in such proportion as the calorific power of the fuel and refractability of the ores will best allow, which is best ascertained by practice, and such a proper quantity of lime or other flux is also to be added as the chemical composition of the ore will require. The charge is put into the furnace, in such a manner as to avoid the escape of any volatile product, other than through the chamber of condensation. The working of the furnace is the same as that followed in the working of iron ore, taking care to work with a highly-heated blast, and with closed breast, the object being to obtain a slag highly charged with lime, by which means the induction of the metallic oxides is more completely insured, and their carburation, as far as iron is concerned, more certainly obtained. The mixture of cast-iron and copper thus obtained is tapped out like common cast-iron, in the most advantageous shape for the refusion, and the operation is thus conducted with great economy of labour and combustible matter without

any interruption. The pigs of mixed metals thus obtained are melted in a cupola; and the melted metals are, by a disposition which keeps them at a high state of temperature, allowed to separate by difference of gravity, the copper precipitating under the cast-iron, this containing one-half or one quarter per cent of copper, and the copper from 20 to 25 per cent. of iron, which is allowed to run out of the cupola in an air furnace, which is kept at a high temperature. Finally, to allow more complete separation of the metallic copper from cast-iron, the proportion of that metal left mixed with the copper is further separated, by means of the usual mode, followed in the reforging of black copper in the furnace when it has been tapped out of the cupola.

The claim is to "the mode of calcining the ores and fusing them in a blast furnace as before described, and also to the mode of separating the metals obtained in the treatment of the blast furnace by liquidation as before described."—*Mechanics' Magazine.*

MISCELLANEOUS.

NEW CHURCH AT FAISLEY, YORKSHIRE.—A subscription is in progress for a proposed new church at Faisley, in the parish of Calonby, in the West Riding of Yorkshire. The parish contains 22,000 inhabitants, with church accommodation for only 3,500; it is therefore proposed to erect an additional church at Faisley, a hamlet containing about 2,600 souls, at the distance of a mile and a half or two miles from the parish church. The estimated expense is £1,500, including the required fund for repairs.

ARTESIAN WELLS.—M. Degousée has published an account of some recent results in the making of Artesian wells, in which he states that he has bored for water in the plateau which extends from Lagny to the forest of Arminvilliers, at the height of 110 metres above the Marne. In one spot an abundant supply of water rushed out, although he had gone to a depth of only nine metres. With M. Degousée's report he forwarded to the Academy of Sciences at Paris a letter which he had received from Aimé-Bey, the director of the mines of Egypt, who announces his intention of re-opening some of the bored wells of the ancients, at the foot of the Libyan chain, and requests that the necessary instruments may be sent out to him for that purpose.

COAL-FIELD OF LANCASHIRE.—Peel and steam-power may be mentioned as pre-eminently forming part of the local advantages of Manchester. It has been calculated that the available coal beds of Lancashire amount, in weight, to the enormous sum of 8,400,000,000 tons. The total annual consumption of this coal, it has been estimated, amounts to 3,400,120 tons. Hence it is inferred, that the coal-field of Lancashire, at the present rate of consumption, will last 2470 years. 2,000 persons, it is believed, are employed in supplying Manchester alone with coal.

MAIL COMMUNICATION WITH IRELAND.—It is stated in a local journal, that the Committee appointed to inquire into the question of mail communication with the south of Ireland "have reported favourably of Brean, near Uphill, in the Bristol Channel, as a packet station. A deputation sent down to view the spot, arrived (it is added) at Brean, by railway, in the short space of 5 hours, and were very favourable impressed with its advantages." Should the arrangement referred to be carried into effect, its influence upon the prosperity of the Exeter Railway will be very beneficial.—*Railway Times.*

MR. WEALE is preparing for publication a most interesting Work, both in a popular and scientific form—a memoir of the mechanical construction of the Syracuse and Utica Railroad, in the United States. The great merit in this railway consists in its simple constructive timber work, and consequent cheapness of execution, having cost less than £190,000. It will form a fine study for engineers on the Continent, and in parts of Great Britain where timber is abundant. Tanner in his book on the Canals and Roads of the United States, p. 78, states "The company received for tolls in five months 117,614 dollars; equal to 12 per cent on its cost, or 30 per cent. per annum. We understand there are to be 22 plates of the joinery and carpentry of bridges, as well as plates of pile-driving, rail-bearings, &c., together with ample text.

ELECTRIC TELEGRAPH.—We learn, with much satisfaction, that negociations are far advanced for laying down the Electric Telegraph of Messrs. Cooke and Wheatstone on the South-Western Railway to Portsmouth. Her Majesty's Government take a very lively interest in the matter. We understand, also, that the patentees are actively engaged in preparing an apparatus for one of the French railways. We trust the time is not far distant when so valuable an invention will be applied to every principal railway in the kingdom. Upon trunk lines it ought at once to be adopted. —*Railway Times.*

LIST OF PATENTS.

(*Continued from page* 224.)

(SIX MONTHS FOR ENROLMENT.)

Thomas Bell, of Saint Anstill, Cornwall, mine agent, for "improvements in the manufacture of copper."—Sealed July 29.

Jules Lejeune, of Regent's Park, engineer, for "improvements in accelerating combustion, which improvements may be applied in place of the blowing machines now in use.—Sealed July 29.

John Stephen Woolrich, of Birmingham, chemist, for "improvements in coating with metal the surface of articles formed of metal or metallic alloys."—Sealed August 1.

Alfred John Phipps, of Blackfriars-road, gentleman, for "certain improvements in paving streets, roads, and ways."—Sealed August 1.

Joseph Whitworth, of Manchester, engineer, for "certain improvements in machinery or apparatus for cleaning roads, and which machinery is also applicable to other similar purposes."—Sealed August 2.

John Dry, of Beverley, agricultural implement maker, for "certain improvements in thrashing machines."—Sealed August 2.

Samuel Carson, of Covent Garden, gentleman, for "improvements in purifying and preserving animal substances."—Sealed August 3.

Archibald Turner, of Leicester, manufacturer, for "improvements in the manufacture of muffs, tippets, ruffs, mantillas, cloaks, shawls, capes, pellerines, boas, cuffs, slippers, and shoes."—Sealed August 3.

John Lee, of Bermondsey, gentleman, for "improvements in wheels and axle-trees to be used in railways, and in machinery for stopping on, or preventing such carriages from running off railways, which improvements may also be applied to other carriages and machinery."—Sealed August 3.

Charles Henri Perrin, of Lombard-street, London, for some "improvements in the construction of certain parts of the mechanism used in watches and chronometers, which improvements are also applicable to some kinds of clocks."—Sealed August 8.

David Napier, of Millwall, engineer, for "improvements in steam-engines and steam-boilers."—Sealed August 9.

Thomas Walker, of Birmingham, stove-maker, for improvements in stoves."—Sealed August 9.

Richard Ford Sturges, of Birmingham, manufacturer, for "a certain improvement in the manufacture of Britannia metal and plated wares." Sealed August 10.

Dominic Frick Albert, of Cadishead, Doctor of Laws, manufacturing chemist, for "a new combination of materials for the purpose of manufacturing a manuring powder."—Sealed August 10.

Moses Poole, of Lincoln's Inn, gentleman, for "improvements in paving or covering roads and other ways."—Sealed August 11.

Joseph Betteley, of the Brunswick Anchor Works, Liverpool, chain cable manufacturer, for "improvements in windlasses and machinery for moving weights."—Sealed August 11.

John Thomas Betts, of Smithfield Bars, gentleman, for "improvements in covering and stopping the necks of bottles."—Sealed August 11.

George Roberts, of Liverpool Road, miner, for "improvements in the construction of lamps."—Sealed August 15.

William Raybould, of Clerkenwell, brass founder, for "a new or improved soldering iron."—Sealed August 19.

George John Newbery, of Cripplegate Buildings, artist, for "certain improvements in producing damask and other surfaces on leather and other fibrous substances and fabrics."—Sealed August 18.

Nathan Defries, of Fitzroy-square, engineer, and Nathaniel Fortescue Taylor, of Mile-end, engineer, for "improvements in meters for gas and other fluids."—Sealed August 18.

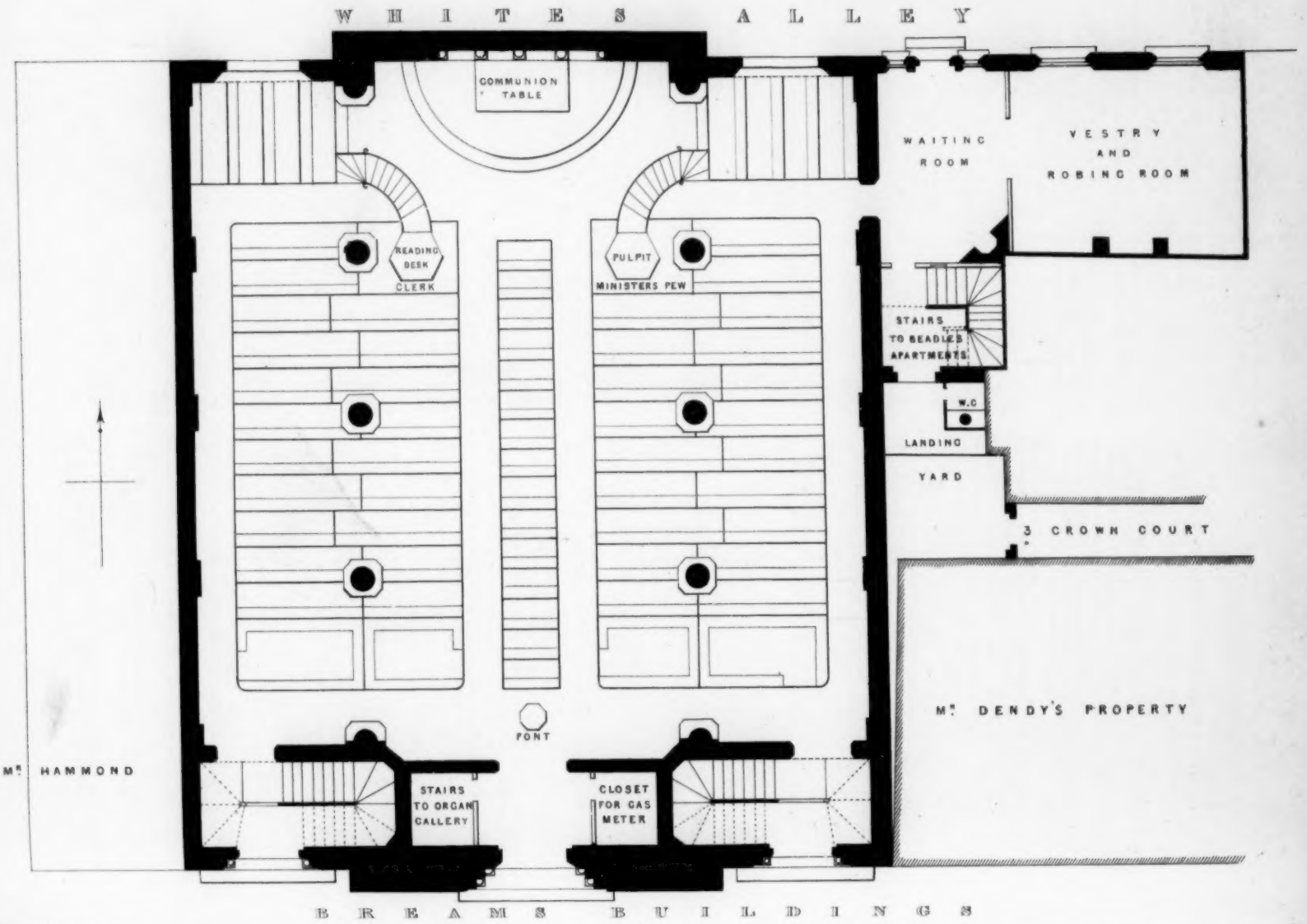
William Ridgway, of Stafford, earthenware manufacturer, for "a new method of conveying and distributing heat in ovens used by manufacturers of china and earthenware, and brick, tile, and quarry makers."—Sealed August 18.

Goldsworthy Gurney, of Great George Street, gentleman, for certain improvements in apparatus for producing, regulating, and dispensing light and heat."—Sealed August 18.

Richard Else, of Gray's Inn, esq., for "certain improvements in machinery or apparatus for forcing and raising water and other fluids."—Sealed August 18.

Thomas Hendry, of Glasgow, mechanic, for "certain improvements in machinery for preparing and combing wool, and other fibrous materials." —Sealed August 25.

David Redmund, of City Road, engineer, for "improvements in hinges or apparatus applicable to suspending or closing doors and gates, and other purposes."—Sealed August 25.

GROUND PLAN OF ST THOMAS'S CHURCH IN THE LIBERTY OF THE ROLLS.

ERECTED 1842. CHRISTOPHER DAVY & J. JOHNSON, ARCHTS